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THE MODEL ENGINEER

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SMOKE RINGS

Our Cover Picture

● WE ILLUSTRATE here four of the most active prototype boats of the Victoria Model Steamboat Club, together with their owners, who, with one exception, are also the constructors. These boats have taken part in many recent regattas, not only on home waters but also at places far afield in the Provinces, and all have won honours in steering and nomination events. The boat on the left is the cruiser *Conquest*, built many years ago by the late Mr. Godfrey, and now owned by Mr. Dinelli, who is seen in the photograph. The workmanship and detail work in the hull and deck fittings are of a high order, and it is fitted with a powerful and reliable steam plant. Next is Mr. J. B. Skingley's motor launch *Josephine*, also a good example of boatcraft, with a 30 c.c. four-cylinder "Seal Major" engine installed: a speedy, straight-running and reliable boat. Mr. Phillips's cabin cruiser *Kenvera* also has a good record for consistent running, and is often to be seen towing a good dinghy-load of children round the pond; it is equipped with a 30 c.c. single-cylinder water-cooled o.h.v. engine. On the right is Mr. Jones, with *Fidelis*, which also achieves a high efficiency with a 15 c.c. single-cylinder four-stroke engine of the "Kittiwake" type, adapted to water-cooling. The very wide variety in the types of boats to be seen at regattas, not to mention the details of their hulls and engines, provide a never-ending source of interest which accounts for the growing popularity of models in this class.

The Blue Riband

● OUR RECENT claim that the old *Mauretania* held the Blue Riband of the Atlantic for 27 years seems to have been rather wide of the mark. We obtained the information from a source which, hitherto, we have regarded as unimpeachable, but must henceforth treat with some caution! *Mauretania* held the record from 1907 till 1929, a period of 22 years, and then lost it to the German liner *Bremen*.

Since that time, successive holders of the Riband have been: the Italian *Rex* in 1933; the French *Normandie* in 1934; our own *Queen Mary* in 1936; the *Normandie* again in 1937; *Queen Mary* again in 1938, and lastly the American *United States* in 1952.

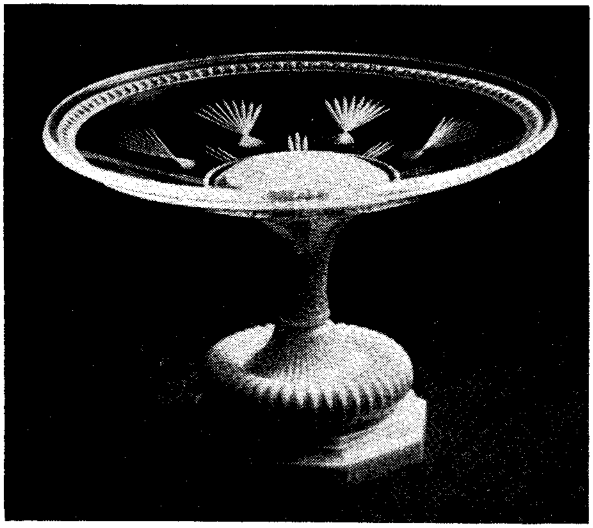
This list gives, very briefly, a clear picture of the closeness of the contest. A letter from Mr. C. A. Ramshaw, of Brentford, gives similar information; so we feel that we have now got it right!

The Beyer-Garratt Banker

● IN OUR recent "howler" about the small boy who spotted a nine upside down, there was actually a "howler" within a "howler," in that something went wrong with the notation of the wheel arrangement. The engine is a massive one consisting of boiler, coal-bunker and water-tank mounted on a large frame which is carried on two, wheeled chassis articulated back to back. The correct rendering of the wheel arrangement is 2-8-0 + 0-8-2. We apologise!

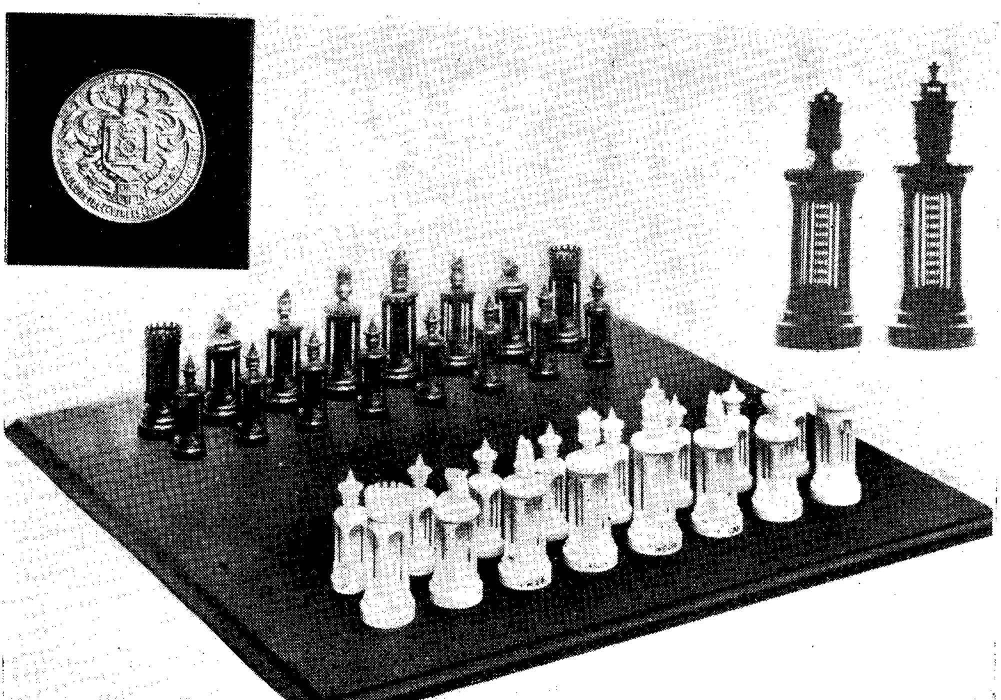
The Revival of Ornamental Turning

● THE CURRENT issue of the *Bulletin of the Society of Ornamental Turners*, which has kindly been submitted to us, contains a good deal of interesting technical material, including descriptions of some excellent work executed by members, and how it was made. Two of the items described gained high awards in the recent prize competition of the Worshipful Company of Turners, namely, a set of ivory chessmen by Mr. F. W. Sharpe, and a multiple entry comprising two table lamps, ring stand, and an ivory and Perspex tazza by Mr. A. V. Reed. The Master of the Company expressed warm approval of the quality of the exhibits, though they were few in number, and exhorted members not to hide their light under a bushel, but to display it on all possible occasions and spread interest in the art of turning.



An ivory and Perspex tazza constructed by Mr. A. V. Reed

Although ornamental turning was once a very popular pastime, it had declined during the present century and at one time seemed in danger of becoming a lost art. For many years the prize competition of the Worshipful Company of Turners had been held in abeyance, but its revival offers new encouragement and a new avenue of activity to craftsmen. Although specialised equipment for ornamental turning is difficult to acquire, much can be done in making or adapting existing tools, and the introduction of new materials, such as plastics, gives much scope for the exercise of artistic ability and skill in this class of work.



A set of ivory chessmen by Mr. F. W. Sharpe

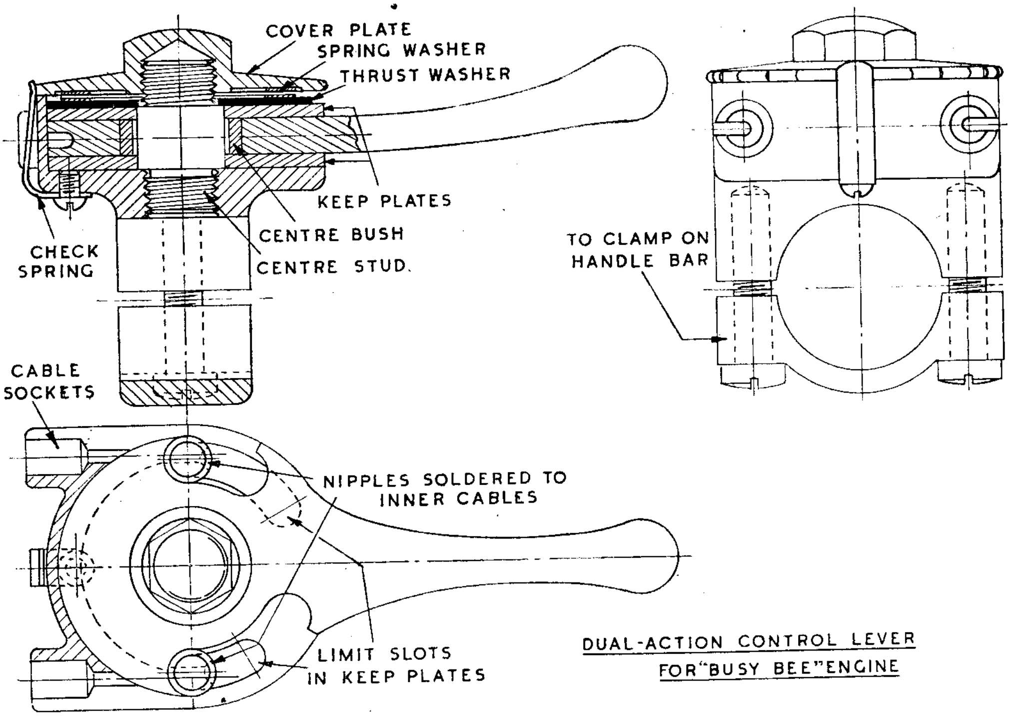
A Control Lever for the "Busy Bee"

by Edgar T. Westbury

NEARLY all the modern engines applied to pedal cycles are controlled by a single handle-bar lever which actuates the Bowden cables of both the carburettor throttle and the decompressor valve, in alternate directions of movement. This arrangement is very convenient, and avoids complication of controls, an important asset from the aspect of the rider who is making his first venture with power drive, but the practical working-out of the idea often leaves something to be desired. In the attempt to lighten and cheapen the controls, they are often made over-flimsy, and liable to loosen on the handle-bar or lose their adjustment.

One realises, of course, that the makers of these devices must necessarily split hairs in their production methods, in order to keep within the price limits which must necessarily be the main justification for the very existence of cycle motors; but one feels that it would not be unreasonable to ask for at least a little more metal to be put into them. I have had the disconcerting experience of a narrowly-averted crash through failure of a control lever, which completely disintegrated with the engine going flat out, and approaching traffic. That was one time when I was profoundly thankful that the engine was a small one, and the cycle brakes had been kept in good condition! From discussions with other users of cycle motors, I understand that such emergencies are not as uncommon as they should be.

In the control lever illustrated here, I have, therefore, been at great pains to rectify what I believe to be the most serious deficiency in the commercially-produced control levers which I have encountered. Careful (some may possibly say over-elaborate) precautions have been taken to ensure mechanical reliability, both in the fixing of the lever, and the maintenance of its essential adjustments. But I believe that in the circumstances, these matters are of greater importance than they are on a motor-cycle, not only because one must rely upon a single engine control, but also because the vibration encountered with a powered pedal cycle is much worse than with a machine specially designed for power propulsion, by the provision of such refinements as large tyres and spring forks. Even on normal road surfaces, pedal cycles driven much in excess of 12 or 15 m.p.h. get a good shaking up, but when roads are bad, or one drives over cobbles or Continental "pavé," the effect on all mechanical fittings on the cycle must be experienced to be believed. I have seen lamp brackets, brake anchorages, and number plates fractured many times on "motor-assisted" cycles.

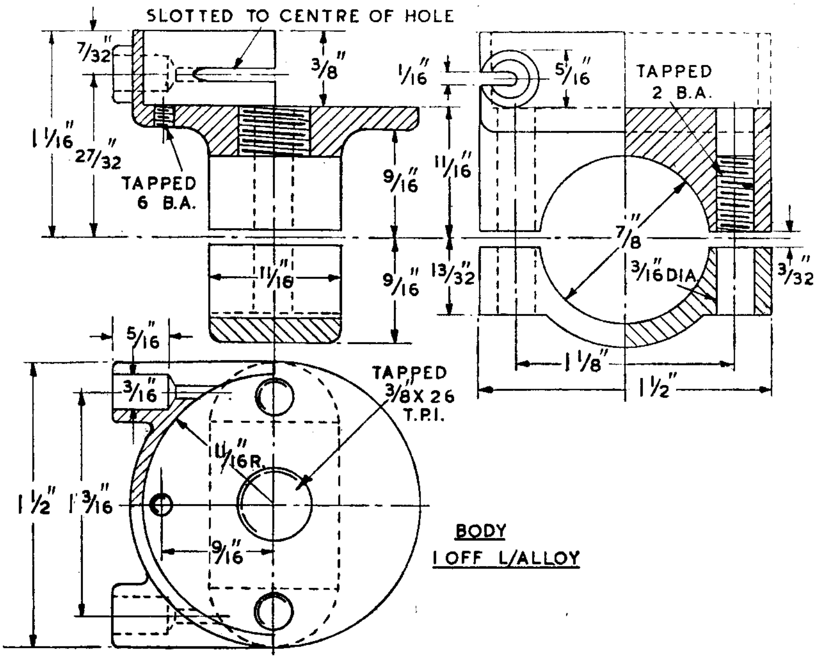


DUAL-ACTION CONTROL LEVER FOR "BUSY BEE" ENGINE

Although the action of this control lever does not differ in general principles from the usual type, there are some details in its design and construction which are unusual and call for brief explanation. The body of the control is intended to be made as a casting, though it could be machined from the solid without difficulty, and is integral with the upper component of the split clamp, by means of which it is secured to the handle-bar of the cycle. To simplify construction, it is proposed to machine the lower half of the clamp also in one piece with the body, and separate it afterwards. Note that the screws or bolts of the clamp are located as close as possible to the seating so that the maximum grip is assured, and any spring or distortion of the clamp which may take place does not impair the grip.

In common with most similar devices, the lever operates on a central stud, and friction is applied by a thrust plate and spring washer so that the control "stays put" when manipulated. But a special feature is that the stud is arranged so that it cannot loosen, neither can the adjustment of the friction washers alter, by any fair means, and the degree of friction can readily be controlled.

The lever operates the cables by what one might aptly describe as "gabhooks," as their action is reminiscent of some of the early types of steam engine valve-gears. Nipples attached to the inner cables by soldering in the normal way, are arranged to be capable of moving in a limited arc, in slots formed in keep-plates above and below the actuating lever. In the position illustrated in the plan view, the lever is in "neutral"; that is to say, both the throttle and the decompressor valve are closed. If the lever is now moved in a clockwise direction, the upper horn of the "gabhook" will pick up the corresponding nipple and pull it round, the cable lying in the circular groove of the lever and having a straight-line motion, with no tendency to bend at the nipple. The lower nipple will be disengaged by its hook, but will be held by the limit slots in the keep-plates so that the cable is neither loosened nor tightened. Movement of the lever in an anti-clockwise direction, however, allows the upper nipple to revert to the position shown, where it is prevented moving further by the limit slots, and further movement of the lever then actuates the lower nipple. It will be noted that the amount of "lost motion" in the hooks of the lever, and also the limits in the slots, varies in the two cases, as the decompressor requires only a small amount of movement to open it fully, whereas the throttle requires a larger range of controlled movement.

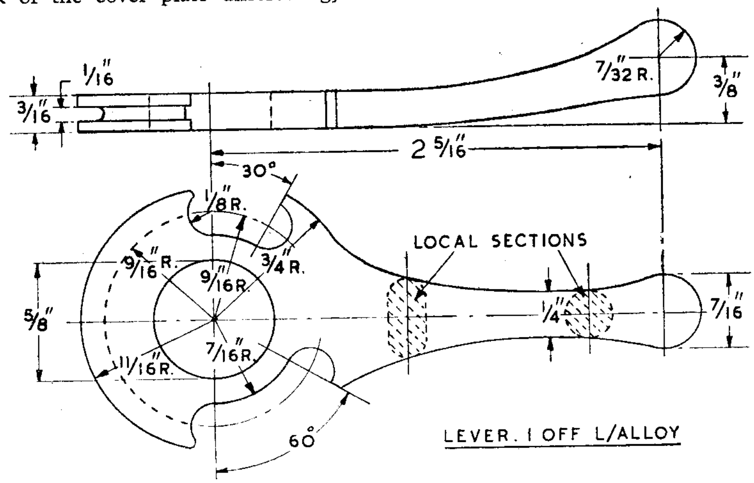


Where this lever arrangement differs from (and is claimed to be an improvement upon) existing types is in the means employed to confine the cable movements to their proper orbits, and avoid the risk that if the cables should stick, the nipples may escape from the hooks and render the control inoperative. The keep-plates also serve the purpose of locked friction pads and prevent any tendency of the cover plate or centre stud to turn with the lever—a prevalent fault of many control levers. It will be seen (from the detail drawings) that the keep-plates have half their circumference rebated so that they are restrained from turning, when assembled, by the semi-circular wall on the left side of the body; and the plates, in their turn, are provided with hexa-

gonal centre holes which fit over the centre part of the stud and prevent it unscrewing from the body.

Frictional pressure on the large area of the keep-plates is applied, through a plain thrust washer, by means of a large spring washer, which is pressed down by a cover plate internally screwed to fit the top end of the centre stud. To prevent risk of the cover plate unscrewing, it is provided with a notched edge, to engage a check spring attached to the body of the control. This locking device is equally effective, whether the cover plate is screwed down hard to make contact with the edge of the body, or partially slackened off; thus the friction can be adjusted to a nicety, and the effect of any possible wear compensated.

I do not claim that this is the "control to end all controls"; from the aspect of the manufacturer, it would probably be considered too expensive to produce, and there may be criticisms of its weight and bulk, in comparison to the popular modern "streamlined" production. But I hope that my critics (and they are legion!) will at least give me credit for the very careful thought put into the design, and agree that the "refinements" are desirable and effective.



Body

If a casting is used, it should be in good quality alloy, and free from flaws or porosity, which would seriously impair its strength. As an alternative to aluminium alloy, gunmetal would be a highly suitable material, but unless it is to be plated afterwards, its colour might be an objection. As previously mentioned, the clamp may with advantage be cast in one piece with the body, but in any case, the recommended procedure for machining is to hold it first by the lower end in the four-jaw chuck for machining the recessed face of the seating, the inside and top face of the semi-circular wall, and drilling and tapping the centre hole. These are all quite straightforward operations, and do not call for specially close limits of accuracy.

For boring the clamp seating, the simplest method of holding the work is on an angle-plate, using a single stud with the end screwed to fit the centre stud hole and a parallel distance-bush or thick spacer to bear on the flat seating face and deep enough to clear the semi-circular edge. The stud should not project through the centre hole to interfere with the boring operation. Set the bore of the clamp to run truly and bore it out to the size of the handle-bar, as closely as can be measured by the means available, but erring, if anything, on the easy side.

Before splitting the clamp, it is advisable to drill and tap the holes for the clamping screws. Note that the drawing shows these holes passing right through into the body to facilitate tapping, though not necessarily tapped their full length. An alternative to the use of screws, which may be preferred on the ground of reliability, is to fit studs or bolts; the holes may be counterbored to ¼ in. dia. at the top, and long screws, with the heads reduced to ¼ in., put in from this end.

The clamp may now be separated with a hand or machine saw, and the faces machined or filed up so that when fitted to the handle-bar there is a definite gap between the halves, with due allowance for any subsequent closing up by distortion of the clamp. Holes are drilled and counterbored in the horizontal bosses to form the sockets which locate the ends of the cable casing, and these are slotted out as shown to facilitate cable assembly. This operation can be carried out by mounting the work on the vertical side of an angle-plate on the lathe cross-slide, using the centre stud and distance-piece as before, and running a circular slotting saw of appropriate thickness on an arbor in the chuck or between centres. Another method would be to set the work eccentrically on the faceplate and use a narrow parting tool, to deal with each of the bosses in turn.

Lever

This can also be dealt with to best advantage if made as a casting; if made from solid, it will entail a good deal of cutting away, unless there is more or less drastic departure from the shape shown. It will, however, be found that the bulbous end is most convenient for finger operation,

and the slight bend carries the lever well clear of the handle-bar. In the old days, levers were often fitted with neat turned wooden or vulcanite handles at the ends, and this idea might be adopted, the end of the lever being made in the form of a screwed stud, with a cap nut fitted to the end. In this case it could be made from $\frac{3}{16}$ in. thick flat brass or dural, but beware of weakening the section where it is shouldered down to take the handle.

If a casting is used, the flat portion should be machined and truly bored through the centre, with care to get the sides parallel with each other. The " hooks " may be filed to shape, but machining of the circular edge and groove is desirable, and this can be done by mounting the lever on a stud fixed to the side of an angle-plate on the lathe cross-slide. Either the stud, or a bush fitted thereto, should be a working fit in the bore of the lever, and a nut and friction washer fitted to enable the lever to rotate somewhat stiffly. A side milling cutter may then be used to machine the edge, and a small circular saw to form the groove. The drawings show the bottom of the groove rounded, but this is not important, as a square-cut groove will fulfil the purpose of guiding the cable equally well.

(To be continued)

The North London S.M.E. Exhibition

THE North London Society of Model Engineers held their exhibition in a different place this year. St. John's Hall, Friern Barnet Lane, Whetstone, N.20, may be a smaller one than last year but what it lacks in space it makes up for in novelty For instance, the locomotive track starts, station like, under cover but extends " out into the country," and from the track, passengers obtain a view of the model car race track. At night both were illuminated with electric lights. The great advantage of this system is that the steam enthusiasts with their internal-combustion-engine colleagues can both let themselves go without filling the main hall with smoke and fumes to the detriment of viewing the other models.

The kidney-shaped model car race track was very busy, never a dull moment. It is known as the " Silverwood Circuit " ; it is completely transportable and consists of four road tracks mounted on hardboard sections. Arranged effectively in the garden at the back of the hall with the smallest loop embracing the base of a large oak tree. This was 3 ft. higher than the opposite side. Cars started off slightly downhill, swept into the first left-hand bend and commenced to climb on leaving the second bend. The club has nearly completed an accurate lap and timing apparatus to cover the four tracks.

Returning to the hall, the locomotives claimed immediate attention. A very nice " Hielan' Lassie " by Mr. A. E. Walker was in steam and running on a stand, an interesting 3½-in. gauge 2-6.0 + 0.6-4 articulated tender locomotive by Mr. H. E. White, which he appropriately calls *Arthropod*, won't be long before it is completed. On the track and kept very much at work was Mr. G. R. Wuidart's new free-lance steam locomotive which one might describe as a modernised G.N.R. Atlantic with outside valve gear. Built to 5-in. gauge and pressed to 80 lb. per sq. in., she has a drawbar pull of 40 lb. She simply played with trainloads of grown-ups, making steam so effectively that her driver had to leave the firehole door open to keep her quiet.

A one-man, electrically driven three-rail race car track was the work of Mr. A. E. Dowell ; each car was controlled by a simple push-button switch, so that three people could each race a car. The whole track was made up on hardboard sections and could be fully assembled in about ten minutes. It would just about fill an ordinary living room. It was complete with pits and starting grid.

In one of the rooms off the main hall was the Boat Section. Most of the exhibits had been shown before but new work was in evidence showing this to be a keen section of the club. A very nice radio-controlled cabin cruiser *Sirius Star* with a water-cooled engine, and a coal-fired steam tug *Evelyn May* by Mr. F. W. Thomas, a club member. In the other room off the main hall were housed models of stationary engines working either by compressed air supplied by a horizontal engine adapted for the purpose or by independent coal-fired vertical boilers. In one corner was a lathe set up with a horizontal milling rig. In the main hall again a preview was obtained of the lap and time recording gear mentioned earlier. Also shown was the very accurate r.t.p. boat-timing apparatus. These two exhibits were among those in the Science and Research Section. The Aero Section was poorly represented and is but a shadow of its former self ; this is a pity, as not more than two years ago it was a very flourishing concern.

The " OO " gauge layout seems to get better and better each year. Several new locomotives were spotted and the control was notably smooth working. New scenic effects were noted including a model street, buses, cars, and an overbridge.

One thing your correspondent would like to congratulate the club on is the sensible provision of a centrally placed information desk where a club member was always in attendance and ready to answer all questions. For instance, if you wanted to know just where old "Bill Bloggs" model was or whether " Joe Soaks " was coming tonight, " Information " supplied the answer. New members were enrolled at the same place.

As usual, the mainstay of any M.E. society, the unsung heroines, the wives of members did a splendid job of supplying tea, ices, and refreshments at very modest prices. The notice over the canteen door met with amusement and approval, it read : " Strictly Canteen Staff Only. *Members* please note."

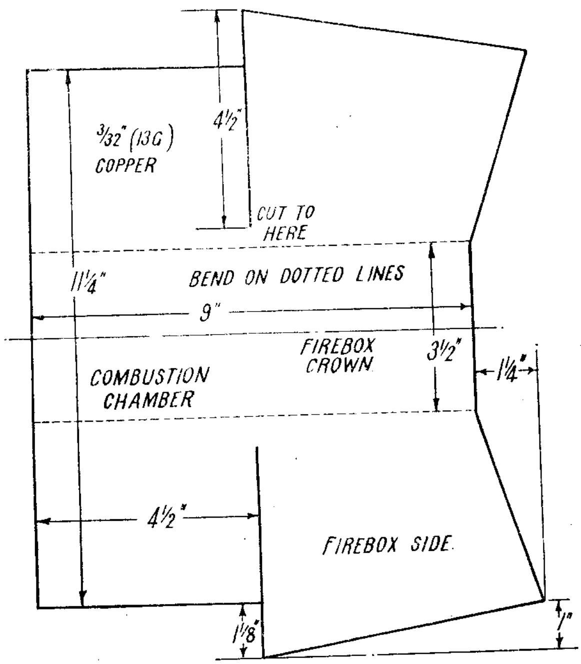
To sum up, if this year's N.L.S.M.E. exhibition was a little cramped for space it certainly was not for ideas and enthusiasm.—C.B.M.

"Britannia" in 3½-in. Gauge

by "L.B.S.C."

Boiler Construction

ON this engine I am specifying and using the "one-piece" construction for the firebox and combustion chamber, as it saves one brazed joint, and it is easier to make the combustion chamber to the size needed. The first item is the door plate for the firebox. A forming plate will be needed for this, made as described for the throatplate, but to the size given in the drawing of the doorplate, less 3/32 in. all around, except at bottom, as indicated by the dotted line. Note that the top edge isn't at right-angles to the side, as the top flange of the finished plate must slope to meet the crown sheet of the firebox, the doorplate being canted to the same slope as the backhead. Lay the former on a piece of 3/32-in. soft sheet copper, mark out a line a full ¼ in. away from it, all around except at bottom, cut out the piece and flange it over the former, as described for throatplate. At 1⅞ in. from the top, draw a horizontal line across the plate; and from the centre of this, set out an oval measuring 1½ in. × 1 in. Cut out the piece by drilling all around inside the line and breaking out the middle, or cut it out with a metal piercing saw (my Driver jigsaw loves these jobs!), but leave the hole a wee bit undersize until you have made the ring. If the edge of the flange is ragged, trim it up with a file, also use the file to clean up the flange itself where it will be attached to the firebox sides and crown.



How to cut out firebox and combustion chamber

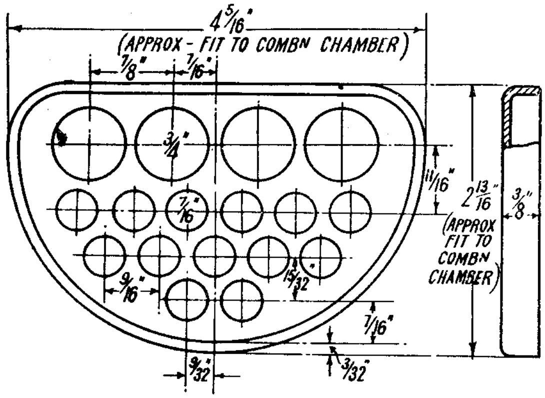
Firehole Ring

The ring is made from a piece of copper tube 1⅜ in. diameter, ⅛ in. thick, and 11/16 in. long. Chuck in three-jaw and turn down 3/16 in. length to 1¼ in. diameter. Reverse in chuck, and turn down ¼ in. of the other end to 1¼ in. diameter, leaving ¼ in. full diameter between the shoulders. Skim a shade off the end to bring the distance from shoulder to end to 7/32 in. Heat the ring to medium red and quench in clean water, or in the acid pickle if you like; then squeeze it oval, until it is the same shape as the hole in the firebox doorplate. File the hole until the 3/16 in. end of the ring will pass through it; clean the ring and all around the edge of the hole. Push the ring through from the side opposite the flange, then beat down the projecting lip of the ring on to the doorplate, so that the plate is held tightly to the shoulder of the ring, as shown in the longitudinal section of the boiler.

Firebox and Combustion Chamber

To make the job as easy as possible, I have included a drawing showing how the combustion chamber and the firebox side and crown sheets, are cut from one piece of sheet copper. A piece of 3/32 in. or 13-gauge will be needed, measuring 13½ in. × 10¼ in. Mark out as shown, and cut to outline. If you haven't a bench shear, use a fine-tooth hacksaw, and put a drop of cutting oil on the blade; this works wonders. The metal is too thick for hand cutting with snips. Note that at the part which will form the front edges of the firebox, a cut 4½ in. total length has to be made at each side. If the copper sheet is at all hard, it should be softened by heating to red and plunging into cold water.

Some folk go to the trouble of making a wooden block to the size and shape of the finished firebox, and bending the sheet copper over it. This is a good wheeze, if you have the time to spare and happen to be good at woodwork; but personally, I just put a bit of round bar in the bench vice and utilise what strength Nature has left in my arms to do the needful. Incidentally, I shan't have to do that much longer, as Bro. Diacro, who presented me with my bench shear, bending brake, rod and tube bender, and



Combustion-chamber tubeplate

rod parter, is sending me one of his latest productions, a bench roller, which will be just the cat's whiskers for making the rounded bends in the top corners of a firebox or a Belpaire wrapper sheet. It will also roll the combustion chamber and short boiler barrels.

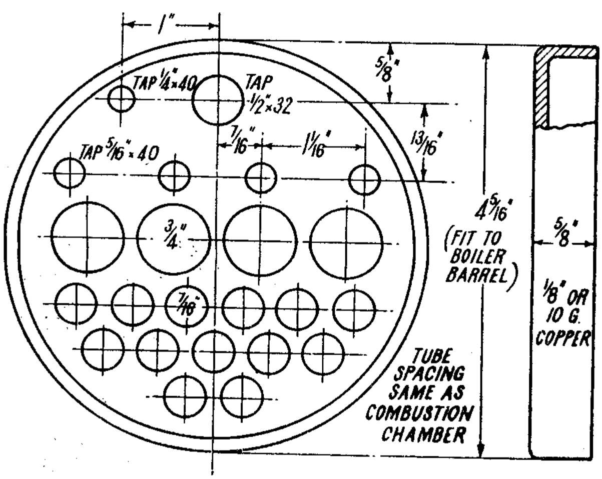
To do the job by hand, first rest the piece of copper on the bar in the bench vice, at the point indicated by one of the dotted lines, and press down at each side until the plate is bent almost at right-angles ; the bar will form the radius in the actual bend. Ditto repeato operation at the other dotted line, and you should then have the whole sheet bent to the shape of the firebox. Now continue bending the $4\frac{1}{2}$ in. portion until the edges overlap, and form the combustion chamber. You won't get it to the perfect shape at the first kick-off, but that doesn't matter a Continental. Get the edges to overlap about $\frac{3}{8}$ in.; put a toolmaker's cramp at each end, to hold the edges in place, then drill a few No. 41 holes through both, at about $\frac{1}{2}$ in. centres, and put 3/32-in. copper rivets in. See that the overlapping edges are quite clean. No need to bother about fancy heads ; Inspector Meticulous can't see through the boiler barrel ! Once the joint is tightly riveted, it will be found an easy matter to coax the combustion chamber to the shape shown in the cross section of the boiler ; but there isn't the slightest need to work to " mike " measurements. When that bit is done, bend the sides and crown of the firebox to the given dimensions, as shown in the cross section of the boiler.

Throatplate for Combustion Chamber

This is made from a piece of 3/32-in. or 13-gauge sheet copper, and can be flanged over the former used for the doorplate. Bend the upper part, as shown in the longitudinal section of the boiler, and then cut out the semicircular piece to the same size as the end of the combustion chamber, measured on the inside. Put the throatplate in place, with the flanges against the sides of the firebox, and the front butting up tightly against the end of the combustion chamber adjoining the firebox, secure with 3/32-in. copper rivets through flanges and firebox sheet, spacing them at about $\frac{1}{2}$ in. centres, or a little more if you like, as they are only to hold the parts together whilst being brazed.

Combustion-Chamber Tubeplate

As the combustion-chamber tubeplate fits over the end of the chamber, like the lid of a coffee-tin, the iron former for it should be the same size and shape as the end of the combustion chamber itself. Saw it from a bit of $\frac{1}{4}$ in. iron or steel plate, finishing with a file and rounding one edge. When done, set out on it the location of all the tube holes, the two lowest being $\frac{7}{16}$ in. from the bottom, and $\frac{9}{16}$ in. apart. The others can be set out from these, according to the dimensions given in the drawing of the tubeplate. Centre-pop and drill a hole at each point, using No. 40 drill ; the former may then be used as a jig for the tube holes in both the combustion-chamber and smokebox tubeplates. Lay the former on a piece of 3/32-in. or 13-gauge sheet copper, draw a line all around it, $\frac{5}{16}$ in. away, and cut out the piece. Then clamp it in the vice, with the rounded-off edge of the former next to the copper, and beat down the flange. Whilst the tubeplate is still on the former, run the No. 40 drill through all the holes, carrying on right through the copper. Remove the flanged plate from former, open out the four upper holes with 47/64-in. drill, and the rest with 27/64-in. drill. Ream $\frac{3}{4}$ in. and $\frac{7}{16}$ in. respectively; don't poke the reamer too far through, as the tubes should be a tight fit in the plate. Countersink slightly on side opposite flange. If the edges of the flange are ragged, file them smooth, also clean around the inside edge of the flange. This tubeplate should fit tightly on the end of the combustion chamber ; the overlap at the bottom can be filed a little, to allow it to enter.

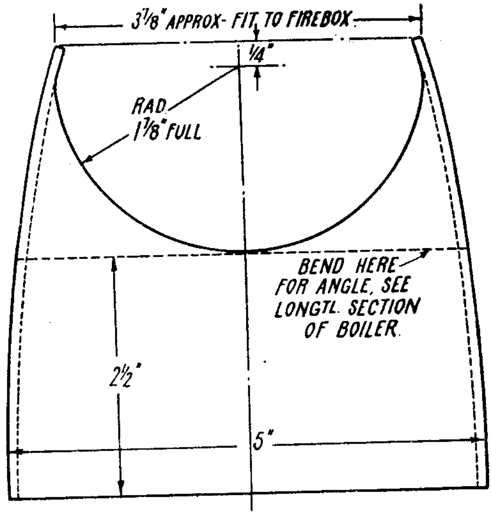


Smokebox tubeplate

Water Tubes

On top of the combustion chamber, draw two parallel lines at $\frac{3}{4}$ in. each side of centre; and on these, set out the location of the upper ends of the water-tube struts. Drill a $\frac{1}{8}$-in. hole at each point. Ditto repeato operations on the underside; but this time draw the lines $1\frac{1}{16}$ in. each side of centre. Then open out all the holes with a 39/64-in. drill, and poke a $\frac{5}{8}$-in. parallel reamer through, putting it through the top hole first and carrying on through its opposite mate below. This will ensure that the water tubes fit properly. Countersink all the holes to about half the thickness of the copper.

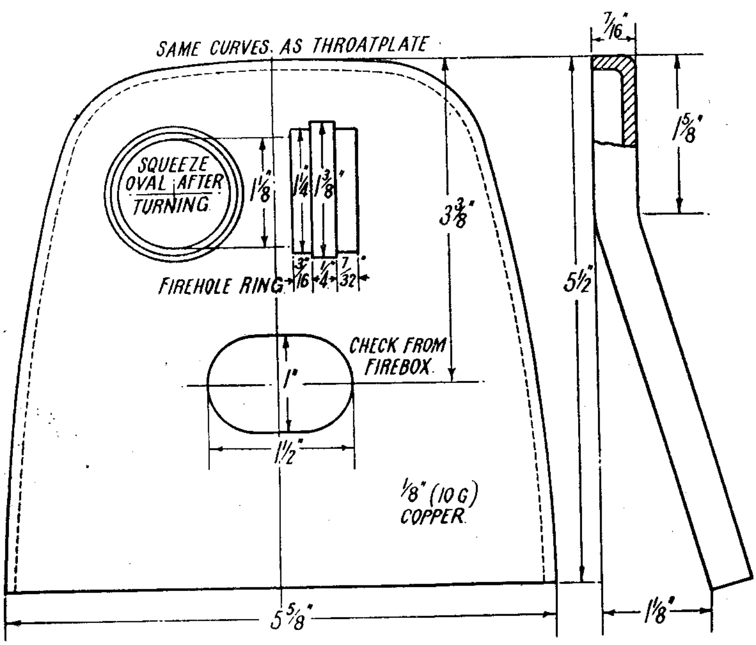
The water tubes are cut from $\frac{5}{8}$ in. × 16-gauge seamless copper tube, and should be long enough to project about $\frac{1}{16}$ in. beyond the chamber at both ends when first fitted. This helps with the brazing; you get a jolly fine fillet all around, completely filling up the countersinks, and there won't be the ghost of a chance of leakage. Some folk are scared of getting a leak in the chamber after the boiler is assembled, and not being able to get at it afterwards; in fact, some few *have* had a leak develop. There is not the slightest fear of this *if the notes and instructions are faithfully followed*; that is the rub! The cases of leakage that have been brought to my notice have either been caused by defective brazing, such as insufficient heat, and neglect to "scratch out" any blowholes due to particles of flux in the molten brazing material; or else by somebody who thinks he can improve on my methods, such as the gentleman who considered that there was no need for a flange on the combustion-chamber tubeplate, and merely butt-jointed it to the chamber. He was a sadder and wiser merchant when his boiler failed on test!



Firebox front plate

Crown Stays

The crown stays are of the girder pattern which I have found to be far better than the rods, as used on the full-sized engines. New readers have often asked why I dislike the rods. It is just another case of Nature refusing to be "scaled"—in more senses than one! Small vertical rod stays have a predilection for wasting away in the middle; I found that out by dissecting some old boilers made to the ideas of one of the old designers now passed on. A boiler made to his specification, with a low firebox crown and rod stays, conked out at a local exhibition when under steam. Fortunately, no damage was done and nobody hurt, as it was only the crown sheet collapsed. The rod stays had wasted away in the middle until they snapped under pressure on the crown sheet. The girders are not only immune from wastage, but they make a much stronger job, converting the end of the boiler into a box girder, which is one of the strongest forms of construction. Incidentally, your humble servant has been very much amused at the way certain critics of the plate girders have gleefully seized on the fact that I specify rods for longitudinal and cross stays, also for firebox stays; well, it merely displays their

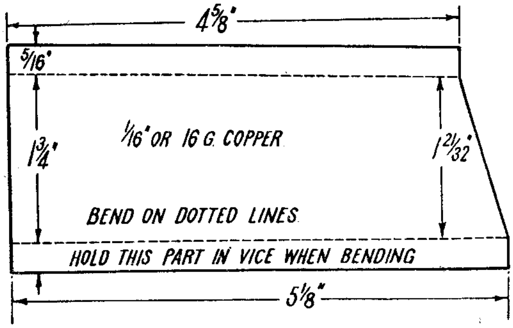


Backhead and firehole ring

ignorance as to what goes on inside the boiler. Maybe I'll explain, for beginners' benefit, in a lobby chat; for the time being, we had better get on with the job.

Each of the side girders is composed of two pieces of 16-gauge sheet copper, bent channel-shape, the flanges being $\frac{5}{16}$ in., wide. Dimensions are given in the detail illustration, which shows one of the channels in the flat, before bending the flanges. The two channels are riveted back to back, and then riveted by the bottom flanges to the firebox crown, using 3/32-in. copper rivets at about $\frac{1}{2}$ in. centres, and spacing the two complete girders at $1\frac{3}{4}$ in. centres, as shown in the cross section of the boiler. Note that the upper flanges slope down towards the back, to match the slope of the Belpaire wrapper.

The centre stay is an arched girder formed by riveting two pieces of angle, made from 16-gauge sheet copper, back to back, and then riveting the whole doings to the crown of the firebox, midway between the side girders. The girders will require a row of $\frac{3}{8}$-in. holes drilled in them,



Crown stay " in the flat "

to allow the wrapper stays to pass through; mark off and drill the side girders first, and then drill the middle merchant by poking the drill through the holes in one of the side girders, taking care to have the drill square and level (" Begob, an' whin did ye see a square dhrill ? " says Pat) so that the cross stays have a clear passage through all three girders.

The backplate, or door-sheet, of the firebox can now be riveted in, using 3/32-in. rivets at about $\frac{1}{2}$ in. centres, as before. The reason why I am specifying a few more rivets than usual is not for the sake of strength—the brazing, if properly done, is far stronger than any riveting—but for the sake of those good folk who have complained that the joints, when held together with just enough rivets to keep them in position, open out under the heat, and melted spelter runs through, forming stalactites, lumps of " almond rock," and unsightly blobs on the plates. Personally, I never have the least trouble; but I do my best to please the followers of these notes.

How to Braze up the Assembly

Complaints sometimes come in, that when a boiler shell, or firebox, is being brazed, joints at the front will crack when the back is being done, and vice-versa. This is due entirely to uneven heating and cooling; if you keep the whole bag of tricks well hot, and let it cool to black in the hot coke or breeze in the brazing pan, there won't be any trouble. In the present instance, if an ordinary blowlamp or big air-gas blowpipe is being used, first cover all the joints thickly with wet flux; Boron compo, or powdered borax, mixed to a paste with water. Stand the assembly right way up in the brazing pan, and pile up a sort of embankment of coke or breeze against it, on the side away from you. Have the blowlamp going good and strong, and all the necessaries—flux, brazing strip, scratching wire and tongs—close to your hand. Heat up the whole lot until the flux fuses; then concentrate on the girder flanges, blowing from the end. When the flanges and the firebox crown glow red, first apply some coarse-grade silver-solder, as a " starter." When this melts and runs freely, " sweating " under the flanges, follow up with the brazing strip. Keep the heat well up, and you'll have the satisfaction of seeing the brazing strip follow the silver-solder's good example. If there is any sign of bubbling, use the scratching wire. Let a fillet of melted metal form along the edges of each flange, and don't forget to cover the rivet heads.

Next, play the flame on the projecting ends of the water tubes, and allow a good fillet of brazing material to fill the the countersink and build up against the tube, attending to each one separately. Then turn the lot upside down, and get the whole underside of the combustion-chamber bright red. A little silver-solder can be run into the longitudinal seam, followed by the brazing strip; then put a good fillet around each water tube. Now up-end the assembly, standing it with the combustion-chamber pointing skyward, and do the sides of the throatplate where they join the firebox sides, in the same manner as the big throatplate was done; work your way around the joint between the throatplate and the combustion-chamber, laying in a good fillet of brazing material, and seeing that it penetrates right through by looking through the holes in the tubeplate. Coarse-grade silver-solder may be applied at the top of the " crack " on each side; make quite certain that it "sweats" in and makes a perfect seal between the sides of the combustion chamber and the throatplate flange. Lay the assembly on its side to do this. You should be able to see the silver-solder showing at the edge of the flange inside the firebox; a good sign that the joints are O.K.

Now stand up the assembly, with the tubeplate resting on the coke, and run a good fillet of brazing material all around the tubeplate flange. You won't be able to crack any of the previously-brazed joints by doing this, as the heat will now be diffused all over the assembly. Also, there is no fear of burning out the tubeplate between the holes, as the blowlamp flame cannot impinge directly on the metal. Finally, do the firebox doorplate flange, and the firehole ring. It is advisable to pile up the coke or breeze as high as you can around the assembly for this job. Start at one bottom corner and work your way

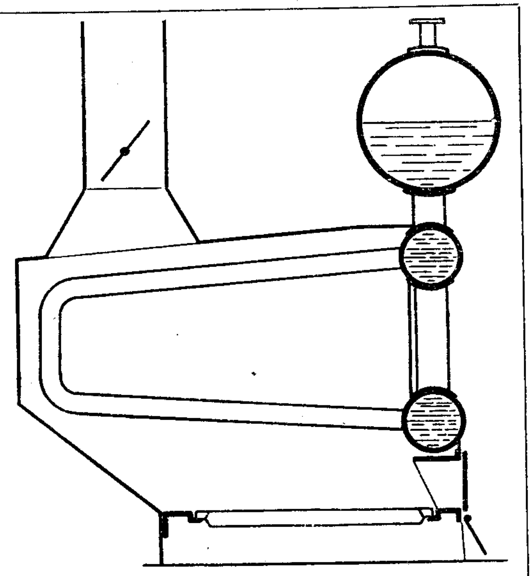
(*Continued on page* 344)

Two Early Water-Tube Boilers

by A. Goodall, A.M.Inst.B.E.

WHILE reading W. T. Barker's article on model marine engines in THE MODEL ENGINEER of March 27th this year, two outstanding examples of early water-tube boilers came to mind, which were put to use for marine work as well as for land work. The earlier one being more or less contemporary to the side-lever engines of 1837, the later being more nearly a contemporary of the oscillating engines and return-acting screw ship engines of 1847 and 1857 respectively.

While it is a fact that the early water-tube boilers were ousted by the Scotch marine shell type boilers for marine use until the turn of the century, and indeed until well into the twentieth century. these two water-tube boilers are of great interest, as they provided a sound basis for future water-tube development. From the marine model engineer's point of view, in combination with their contemporary engines, they provide two worthy subjects, and could be built either as working models with the main idea of being functional only, that is, to provide steam for a model ship with honest-to-goodness sailing in view, or as full scale or semi-scale models for pure exhibition purposes only.



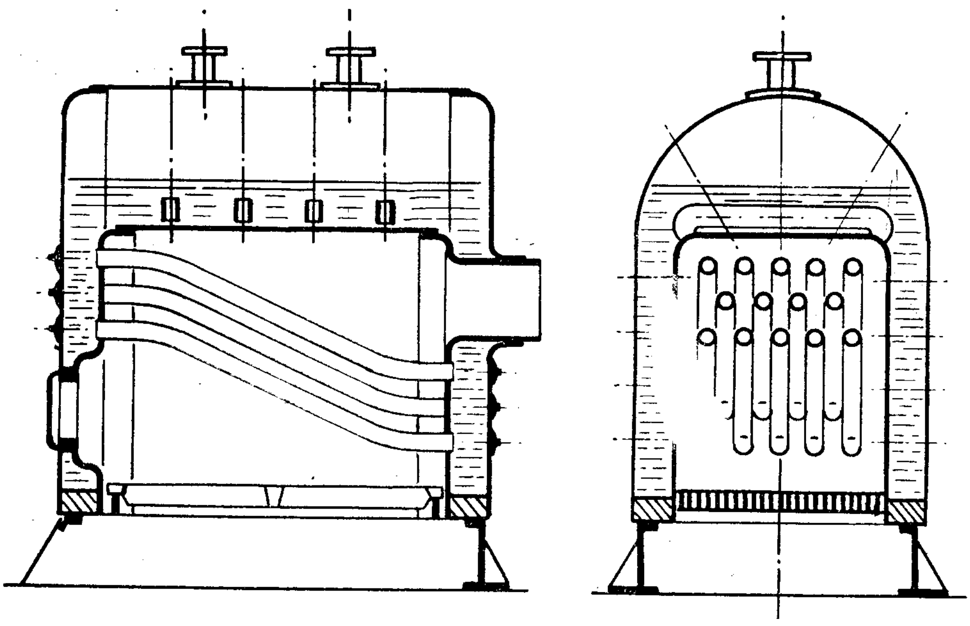
The Gurney boiler—1827

In 1826-27 Goldsworthy Gurney after much experimentation with glass tubing to test his theories on water circulation, produced the Gurney water-tube boiler. It consisted of a large upper drum providing the steam space, connected to a water drum just below it—the top header, which was in turn connected by large pipes—downcomers—to the lower water drum, bottom header, or mud drum. The heating surface consisted of a large number of looped tubes joined to the mud drum, and passing over the firegrate returning in a loop or bend back to connect to the top header. This boiler took on several different forms, one of them as illustrated here. In another form the steam drum was arranged vertically. At this time, much use was made of cast-iron for the drums, and even for the tubes. It would seem that manufacturing difficulties caused tubes to be very scarce. Solid drawn steel tubes were a dream of the future, and wrought-iron plate was used exclusively for boilers until the beginning of the twentieth century—steel plate even at this time being a very unreliable material for boiler work. The writer remembers handling a repair order for "field tubes," in 1937, for a wrought-iron locomotive boiler (stationary type) built in 1895 by Marshalls of Gainsborough—the boiler was still steaming at 80 lb. p.s.i.

Stephen Wilcox brought out the type shown in the second illustration, in 1856. This boiler to all intents and purposes was a locomotive boiler minus the barrel and smoke-tubes. Water tubes straddled the firebox connecting back and front tube-plates, and the flue-outlet passed through the back water leg above the tubes. By 1867 Wilcox had joined company with a Mr. Babcock and the first Babcock & Wilcox boiler had made its appearance, with sectional headers and the long steam drum above the tube banks; generally speaking, being well on the way to the accepted form so well known today.

Regarding the modelling possibilities of these two boilers, it is fairly obvious that Gurney's boiler readily falls into the brazed boiler category, and Wilcox's into the riveted, plated and old-time boiler-maker's class.

A Gurney's type model could be easily modified to suit the high-speed boat fan's requirements, even to flash-steaming and blowlamp firing. Or for the more staid members of the fraternity could be built as a coal-fired boiler with a realistically scaled casing of M.S. plate and angle, complete with all the neat little gadgets such as firedoors, ashpan dampers and flue-dampers. The writer's own formula is; near enough to scale, reasonably realistic in appearance, but above all a working boiler with a decent output. In both cases, whether for a plainly functional boiler or a semi-scale boiler, it is considered that the top header is unnecessary and could usefully be omitted—the top ends of the loop-tubes being turned upwards into the bottom of the steam drum.



The Wilcox boiler—1856

The large downcomers being outside the main tube nest, that is one at each end of the steam drum and dropping down to the extremities of the mud drum.

If the Editor is willing, the writer offers to make a drawing of such a model Gurney, should any reader care to make the request.

Wilcox's boiler is a different kettle of fish. Decent treatment of this type entails plate flanging, riveting staying, and generally speaking, getting down to some first-class boiler making in miniature. The members of engineering societies most likely to make the best job of Wilcox's boilers are those who have spent a long time working on model locomotives. On the original boiler each tube had a hand hole and cover directly opposite in the outer plate to facilitate tube-expanding and cleaning. Pitched in between these covers were screwed stays tying the outer plate to the firebox tubeplates, similar to the old Heinz water-tube boiler plated headers.

The Wilcox boiler is essentially a coal-fired boiler, and, therefore, not so adaptable to various model requirements as the Gurney, but nevertheless could be the subject of a really beautiful model.

"Britannia" in $3\frac{1}{2}$-in. Gauge

(*Continued from page* 342)

slowly around. When you get to the top, where the firehole ring is, blow direct on the joint between ring and doorplate; start with a little silver-solder, and when this runs freely, add the brazing strip. If you run a fillet all around it, and scratch with the pointed wire if there is any sign of bubbling, the joint will be perfect, and it can't possibly leak. Same applies to all the other joints. Remember—plenty of heat, plenty of flux before starting, clean joints, and an admixture of that valuable ingredient known as common-sense, will ensure a sound job. Leave it in the brazing-pan until it has cooled evenly, but still too hot to touch with your fingers; then lower it carefully in the pickle bath (mind the splashes!) leave it in for 20 mins., or so, fish it out with the tongs, and give the whole lot a jolly good wash in the kitchen sink, scrubbing with an old nailbrush or something similar. Then examine all the joints; and there shouldn't be any vestige of a crack or bad place anywhere. The projecting bits of water tube can be filed to within 1/32 in. of the combustion-chamber. Next job will be tubes and smokebox tubeplate.

THE MECHANICS OF RADIO CONTROL

by Raymond F. Stock

A MOTOR-DRIVEN crank with limit switches was arranged to move the operating lever of the gearbox shown in Fig. 18 and Fig. 19, illustrates the layout and circuit used. The three leads **A, B** and **C** were fed from three positions on an 8-step selector, four positions being used for steering (as in Fig. 10) and one spare remaining.

It may be seen that this and similar arrangements (which can be multiplied to any complexity by combinations of the basic units) provide the best solution to comprehensive control within the limitations of a single radio channel. All such systems, however, require more steps in the sequence than can be memorised for instant use " in action " and some form of automatic coding of transmissions becomes necessary. This may be accomplished by a pulsing device integral with or connected to the transmitter.

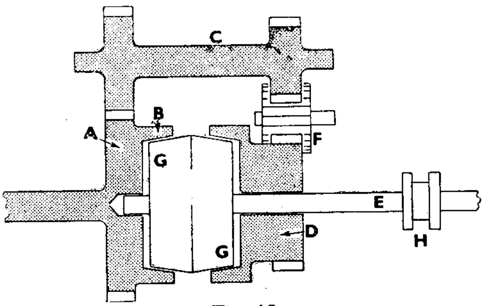


Fig. 18

Pulsing Devices

The simplest and most reliable device is a rotary switch having a suitable number of " click " positions and arranged to key the transmitter as it moves from one step to the next. Often a more realistic control is required obviating the necessity to turn the control in one direction only, and Fig. 20 illustrates a clockwork-driven servo unit.

The drum **A** tends to rotate by the action of a spring motor (**S**), lever **B** restrains it by interfering with one or the other of the pegs **C**, and owing to their angular position the pegs permit the drum to rotate whenever the lever is moved from side to side. Rotation of the drum causes contacts **D** to touch brush **E** and thus key the transmitter H.T.

As shown, the drum is arranged for a 4-step steering control giving Port-Neutral-Starboard-Neutral and was used in conjunction with the escapement shown in Fig. 6.

When this device is used, it is desirable to use a governed clockwork motor so that the drum moves at a reasonable speed and does not **try** to emulate **an** escapement.

When a sequence is compounded of both steering and motor orders, with perhaps additional controls to be operated, it is necessary to use a fully automatic pulse-unit. Fig. 21 shows the rear view of a control panel used in conjunction with the control unit shown in Figs. 10 and 11. The sequence here was " Port going," " Hold," " Starboard going," " Amidships " followed by " Stop Engines " and a spare (generally used for towline release).

In Fig. 21 **A** is a switch arm on the steering wheel shaft and contacts **B, C, D** and **E** represent its position when set to the first four steps noted in the preceding paragraph ; these contacts are wired to brushes $\mathbf{B_1}$ $\mathbf{C_1}$ $\mathbf{D_1}$ and $\mathbf{E_1}$ around the rim of wheel **F.** Switch **G** and push button **H** are wired to brushes $\mathbf{G_1}$ and $\mathbf{H_1}$. Motor **J** is supplied with current *via* wheel **F**, which has one insulating segment **K.** Whenever the steering knob is rotated to a new position or switch, **G**

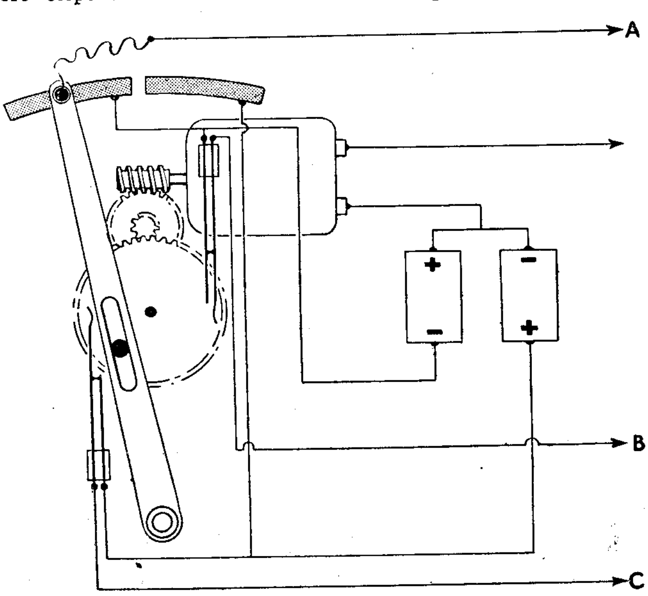


Fig. 19. *When the motor lead is connected to either " B " or " C," the lever moves to " ahead " or " astern " ; connected to " A " it " homes " to " neutral." The principle is similar to that shown in Fig.* 10

Continued from page 325, " *ME.*" *September*, 4, 1952.

(" Stop Engines ") or button **H** (" Release Towline ") is operated, current is supplied to motor **J** *via* a fresh brush; the motor rotates and wheel **F** turns until its dead segment lies under the brush concerned. In doing so, wheel **F** turns through a definite multiple of 60 deg. according to which control was used, and one or more of the six contacts around the periphery of **F** key the transmitter from one to six times as they pass under brush **L**.

The gear ratio between the motor and **F** is arranged to give a pulsing speed of about 8 per sec., which is just within the capacity of the selector in the model to follow when its batteries are due for changing. This means that the greatest time lag in operation of any control is less than one second.

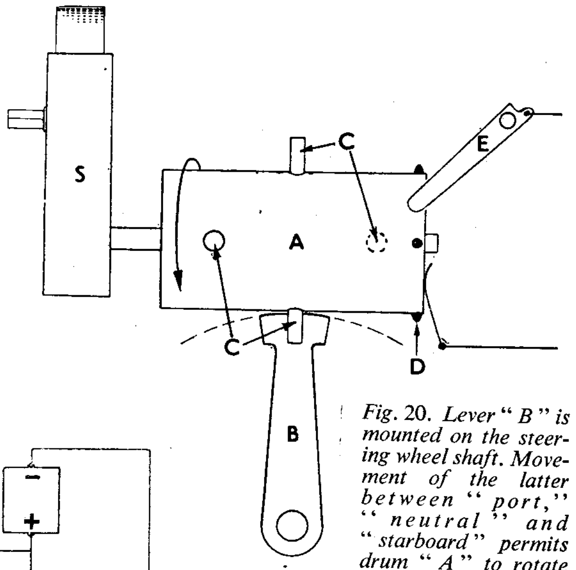


Fig. 20. Lever " B " is mounted on the steering wheel shaft. Movement of the latter between " port," " neutral " and " starboard " permits drum " A " to rotate through a multiple of 90 deg.

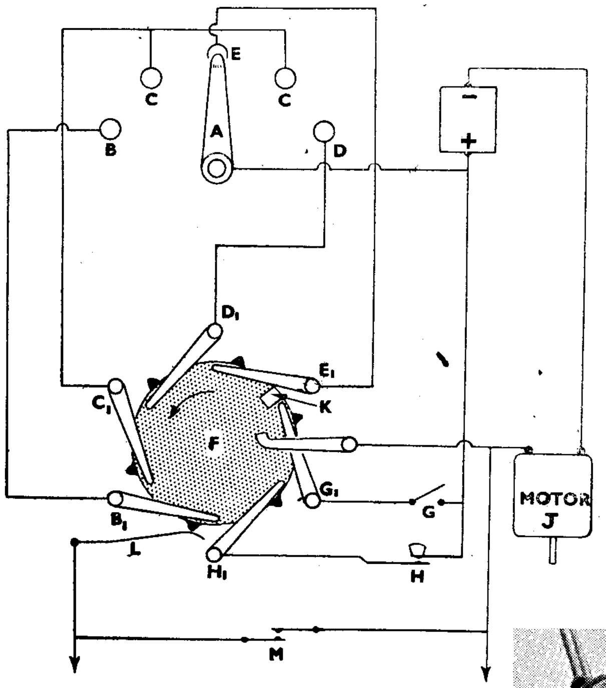


Fig. 21

M is a manual pulsing button—a microswitch—and this should always be included in any automatic control box; it enables one to bring the receiver gear into phase and gets one out of tight corners when the motor-driven device slips up! Though perhaps irrelevant to this article Fig. 22 may be inserted as an example of what happens when the control gear doesn't. The damage was caused by the bowsprit and forestay of a yacht—another reason for keeping the radio gear in the superstructure!

Proportional Control

No type of sequential control is adequate for the steering of a fast motor boat (or practically any type of vehicle). These classes of model require truly proportional steering, which is best obtained by the use of multi-channel radio gear. There are, however, two forms of mechanism which can give a good result and which require only single-channel radio.

The first of these, depending on the transmission of two lengths of pulse was fully described in my article of February 28th, 1952, and will not be dealt with here.

The second system referred to is the one commonly known as the " mark-space ratio " system; it employs a train of pulses continuously (and

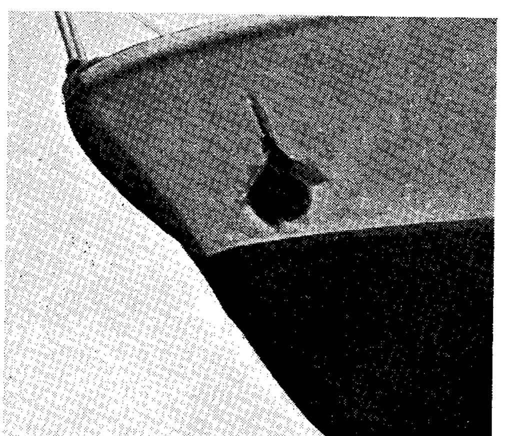


Fig. 22. The planking is double-diagonal

automatically) transmitted, the length of the pulses in relation to the spaces between them being infinitely variable from 100 per cent. (i.e. continuous signal) to 0 per cent. (no signal). The per cent. pulse is related to the position of the steering wheel so that 0 per cent. represents say, full port and 100 per cent. full starboard, 50 per cent. being amidships. This effect is, generally achieved by the mechanism shown in Fig. 23.

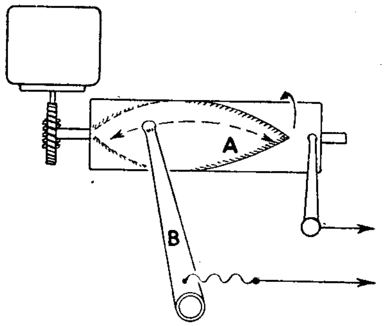


Fig. 23. The drum is continuously rotated by motor and is provided with an insulated segment "A" tapered from 0 deg. to 360 deg. Movement of the control arm "B" causes the pulse length transmitted to vary

One method of utilising these metered pulses is indicated in Fig. 24 and though commonly described, I consider its advantages to be more apparent than real. The relay contacts **A** and **B** are energised alternately by the moving reed **C**, and the motor is thus caused to rotate first in one direction and then in the other.

The rudder, geared down from the motor by a large ratio hardly moves, provided that the motor rotates equal amounts in opposite directions (i.e. provided 50 per cent. pulses are transmitted).

Whenever the pulse per cent. is reduced or increased, however, the motor begins to rotate more in one direction, and the rudder consequently creeps over.

It will be seen that this is not strictly a proportional device in that the rudder will always move eventually to the full position however little the wheel is turned from the central point ; the degree of wheel applied merely alters the *rate* at which the rudder progresses, and to hold a curved course involves first moving the wheel to apply rudder, and then centralising it to retain this rudder angle. Return to amidships obviously then requires application of the opposite wheel for the required length of time.

In practice, the unit does no more than my simple steering unit (Fig. 12) and at a much greater expenditure of electrical energy in both transmitter and model.

The idea of a train of metered pulses can, however, produce proportional results with another form of control gear. One suitable system is really electronic and, therefore, outside the scope of this article, but I have recently experimented successfully with a mechanical system. The idea involves balancing the average value of the incoming pulses (in terms of physical force) against a spring and thus producing a proportional extension.

The most suitable component for this purpose is something on the lines of a moving coil meter ; a burnt-out one being available (one always is in my workshop !) it was rewound with thicker wire and stronger hairsprings were fitted ; the movement was then measured at 20 ohms and

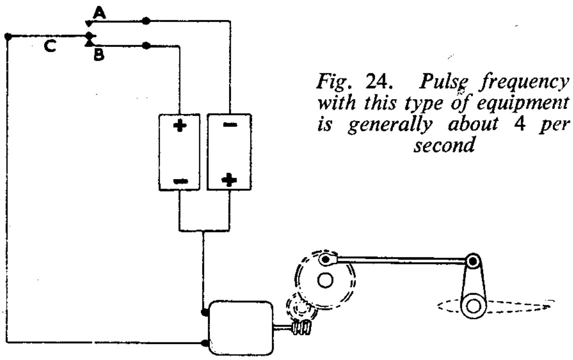


Fig. 24. Pulse frequency with this type of equipment is generally about 4 per second

required 4.5 V to produce full scale deflection (225 mA). This conversion naturally produced a more powerful movement, not capable of applying useful energy but able to operate an electric servo mechanism.

The frequency of pulse transmission was raised to about 35 per second to assist in smoothing the movement of the meter ; a higher frequency would have been beneficial, but the receiver relay refused to follow accurately above this figure.

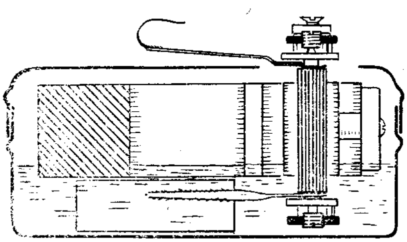


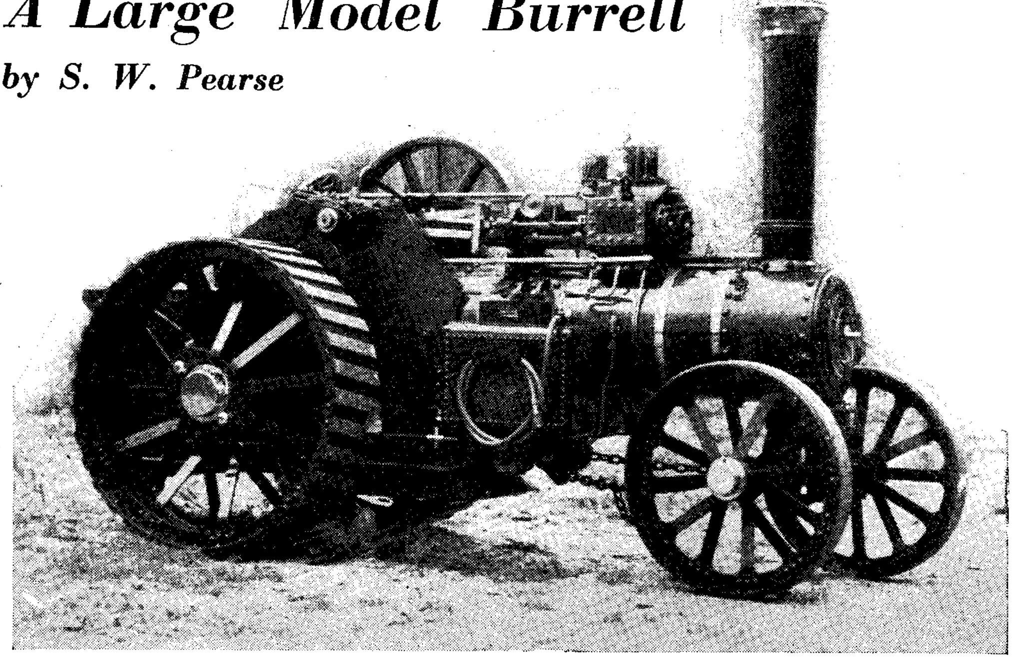
Fig. 25. Section through can and magnet. Overall diameter of can is 2 in.

The degree of oscillation of the needle was further restrained by enclosing the movement in an aluminium can and filling this with oil ; using a thin motor oil and with a brass foil vane fitted to the coil below the magnet, the oscillation of the coil was kept within 5 deg. A longer needle of corrugated brass foil was now substituted for the original pointer and this was arranged to move in an arc just above the top of the aluminium can. Fig. 25 shows a section of the unit at this stage.

(To be continued)

A Large Model Burrell

by S. W. Pearse



THE photographs reproduced here show a large model traction engine which I have constructed in my spare time, occupying about 2,000 hours spread over a period of $3\frac{1}{2}$ years; it represents a Burrell 8 n.h.p. double-crank compound.

All machining was done on an old type Drummond $3\frac{1}{2}$-in. lathe and a bench drilling machine; no shaper or milling machine was used, so all flat surfaces such as cylinder block, valve faces, covers, etc., were hand filed. The flywheel, which is 16 in. diameter by 2 in. face, was machined by a friend who owns a large lathe. All patterns required were made by myself.

The boiler is all copper, $\frac{3}{16}$ in. thick, and all the plates were formed on wood blocks by the usual annealing and hammering method. The firebox is stayed by 150 stays, $\frac{5}{16}$ in. diameter, and the barrel contains eighteen $\frac{3}{4}$-in. flue tubes; the grate is $10\frac{1}{2}$-in. long by 7 in. wide. The whole boiler holds 6 gallons of water, has been tested to 220 p.s.i. and steams very well.

The cylinders are: h.p. $1\frac{3}{4}$ in. bore; l.p. $2\frac{1}{2}$ in. bore; the common stroke is $3\frac{1}{2}$ in.

The road wheels were all built up from steel strip, the local blacksmith's rollers being used for turning up the rims. Rear rims were rolled up from 6 in. by $\frac{5}{16}$ in. steel, the strakes being riveted on with four rivets in each. Hornplates were cut from $\frac{3}{16}$-in. steel sheet.

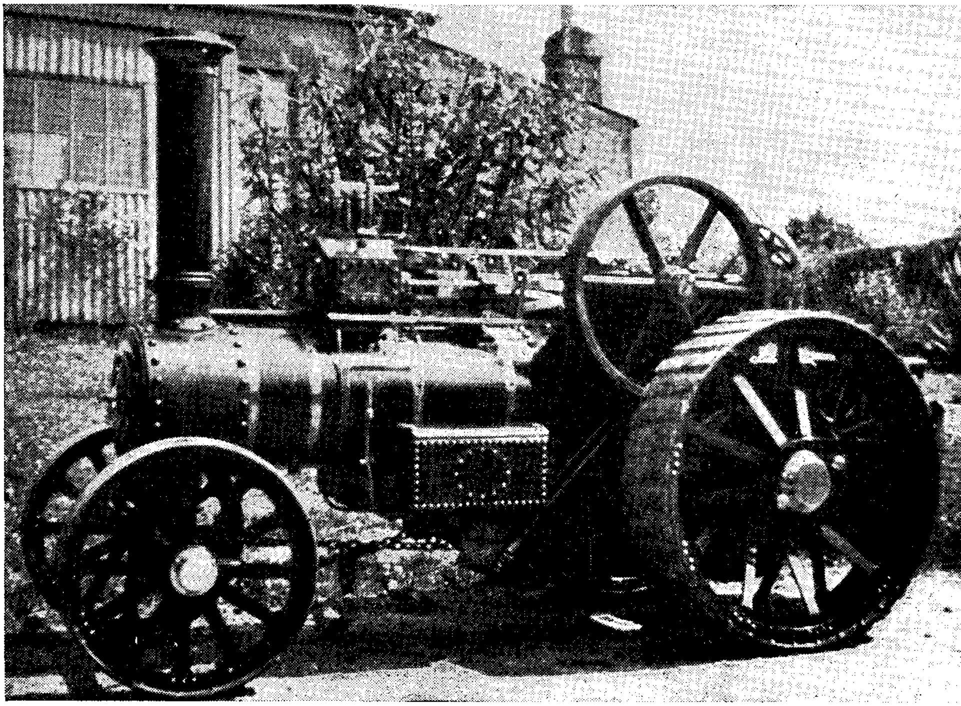
The crankshaft is $1\frac{1}{8}$ in. diameter; it was built up and silver-soldered, and is quite successful.

Fittings and other equipment include three-cock water-gauge, pressure-gauge, pump, injector, water lifter, mechanical lubricator which pumps oil up to a pressure of 160 p.s.i., two-note whistle, twin safety-valve, Pickering governor which controls the engine perfectly, bunker tank and belly tank holding 4 gallons of water, and finally, Stephenson link motion, of course. The only parts which were bought finished were the pressure-gauge, injector, steering worm and gear and some of the transmission gears which were taken from old cars. Some of the gears which could not be obtained had to be cut from steel blanks, with only hacksaw and file to do the whole job; one of these wheels has 96 teeth cut around a steel blank 10 in. diameter and $\frac{5}{8}$ in. thick. The engine has two speeds, differential gear and a winding drum. The canopy is removed and a seat for the driver is fixed in the bunker when the engine is required to do actual work.

As to the capabilities of the engine, it can haul a Morris 8-h.p. car up a 1-in-12 gradient, and will haul a 2-ton load up the same gradient by means of the winding drum; all this on only 60 lb. of steam. It will drive a 12-in. circular saw, and has cut up and hauled a very useful quantity of firewood.

The total length of the engine is 5 ft. 9 in., and the width over the rear wheels is 2 ft. 6 in. The front wheels are 14 in. diameter and the rear wheels 23 in. diameter.

Much of the work in building this engine has gone rather beyond the usual model making, and it has all been done after my day's work.



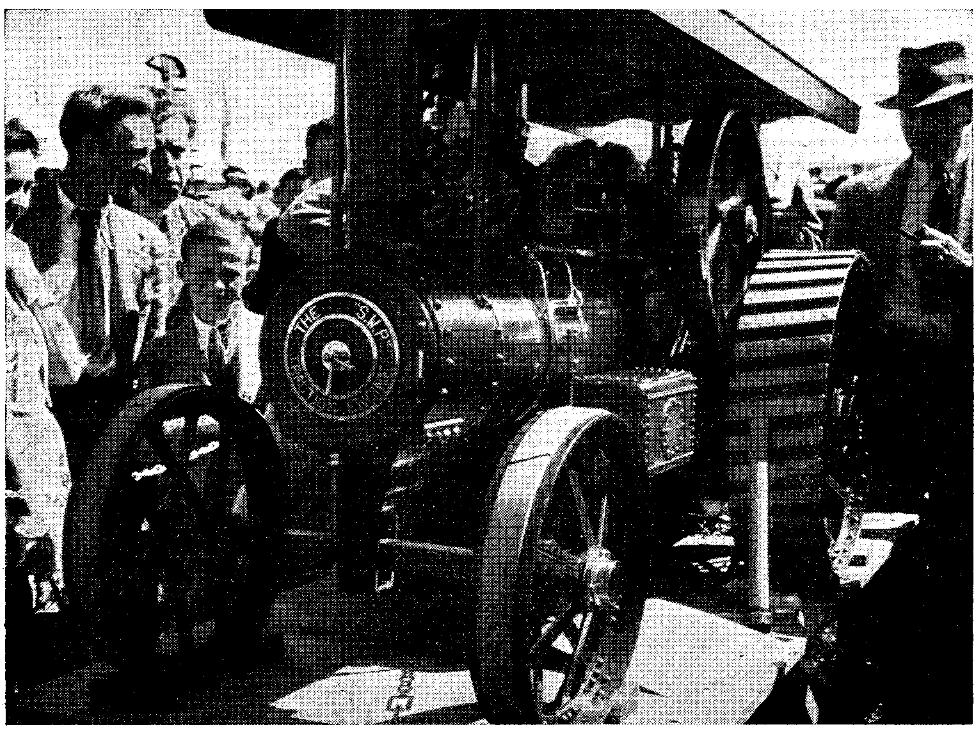


Photo by] [*R. W. H. Wicking & Son Ltd.*
Mr. Pearse's traction engine at the Royal Cornwall Agricultural show at Redruth, June, 1952

A CLUTCH FOR A GEARED-HEAD LATHE

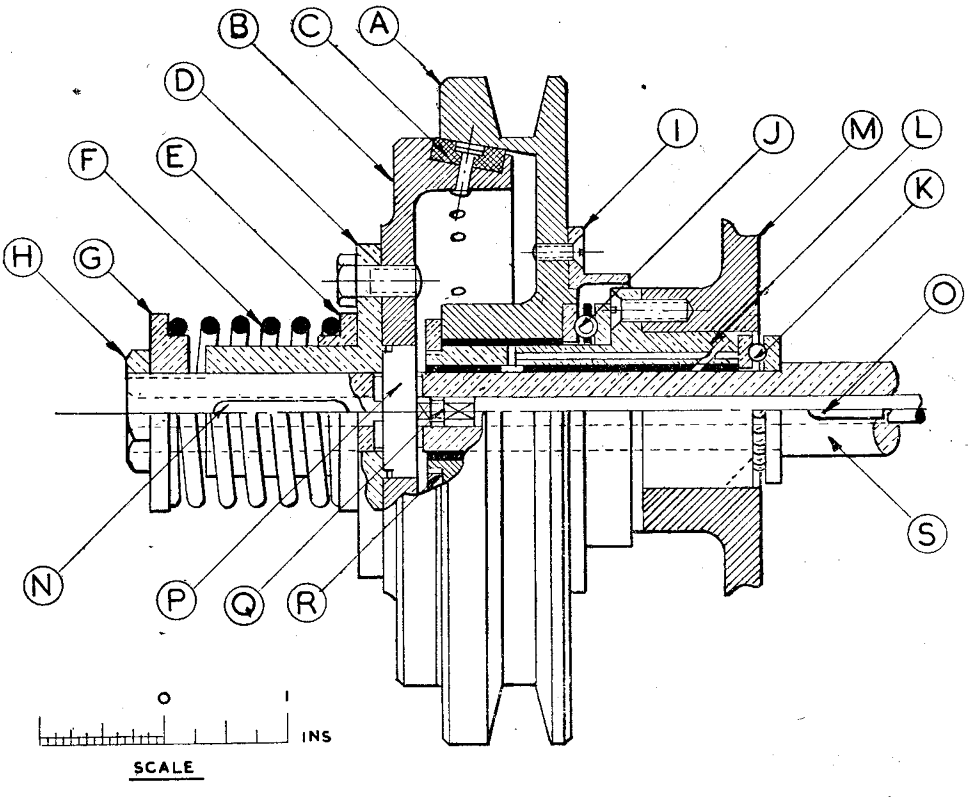
by R. L. A. Bell

THE subject of the following article was a successful attempt to overcome certain characteristics always present in the operation of small motorised geared-head lathes, namely, the "solidity" of the drive and the necessity to "de-gear" to enable the spindle to be rotated by hand when setting-up work.

I was fortunate some time ago to obtain a brand new Murad "Cadet" 4 in. geared-head lathe fitted with a ½ h.p. capacitor-start motor, the motor to run continuously, some form of clutch seemed necessary.

The machine has a V-belt driving pulley situated at the rear left-hand side of the head, and the motor is mounted on a swivelling bracket on the rear of the left-hand standard, the drive being nearly vertical and shielded with a cast cover, all nice and neat.

Several ideas were thought out, but abandoned as being too crude, but the arrangement shown



PART-SECTIONAL SIDE ELEVATION

and I immediately realised the vast difference between it and the countershaft and flat belt drive of my old machine.

The continual starting and stopping of the motor, necessary when setting-up work, and also when screwcutting operations were carried out became rather tedious.

The motor has a very high-torque starting characteristic and the inertia load on the gears was pretty considerable, and so in order to enable

was adopted and has been in use for some time, proving highly successful, and has enabled the following advantages to be realised :—

1. The motor can run continuously, thereby obviating wear and tear of its centrifugal switch.

2. The perfect control necessary when screw-cutting, especially up to a shoulder or when cutting a "stopped" thread.

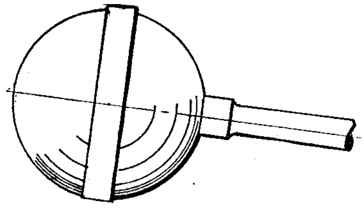
3. "Inching" the spindle when setting-up work, and

4. All belt tension stress and incidental wear is relieved from the headstock driving-spindle bush.

Two simple patterns were made by a friend and iron castings obtained; all the rest was made up from odds and ends from my "scrap department."

The Clutch Unit

Referring to the drawing, the bronze-bushed pulley *A* runs freely on the extension of the headstock shaft bearing *L*, the latter made of steel stock, to replace the original. The pulley is restricted between a thrust-race *J* and a screwed retaining ring *R*, the latter being hardened and locked up tightly to a shoulder, allowing about 0.001 in. clearance against the pulley boss.



A sliding member *B* has on its conical rim a leather face *C* cut carefully to shape, driven into the groove and secured with sunk dural rivets. The leather, $\frac{1}{4}$ in. thick, was obtained from a piece of ordinary flat belting, and after calculating the conical form, a pattern was made by means of which the leather was cut in its true curved form.

After fitting, the face was machined, using a keen, sharply raked tool to an included angle of 19 deg. and reduced until it almost completely entered the pulley member.

The steel sliding sleeve *D* is tightly spigoted in the bore of *B* and is secured by three $\frac{1}{4}$-in. B.S.F. set-screws. A keyway was machined in the bore of the sleeve to engage with a feather key *N* fitted in the shaft *S*.

The latter is made of a piece of nickel-chrome car rear-axle shaft, which, by the way is beautiful stuff to machine provided that the splined ends are left severely alone!

A Fine Art

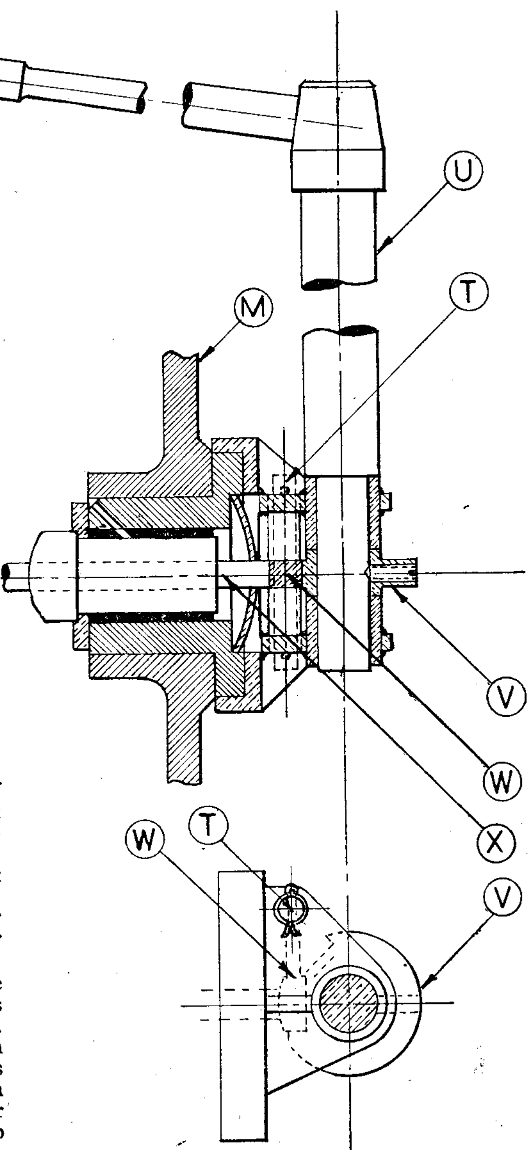
Careful measurements were taken of the original shaft both for diameters and lengths between shoulders, and allowances made in the new one to accommodate the inner thrust-bearing *K*. The taking out and replacement of the original shaft was brought to a fine art during the making of the clutch, as I was determined to make the lathe "do its own work" so to speak, and that shaft practically jumped out to my bidding each time I required it!

To resume, it will be realised that the inner thrust-race *K* is under load all the time, the outer one *J* only when the clutch is engaged.

In order to reduce unit loading due to the restricted size of the inner race, no cage was fitted, the grooves being filled with nineteen $\frac{1}{8}$-in. balls. The outer race *J*, however, is fitted with a cage housing twelve $\frac{3}{16}$-in. balls. The races were carefully machined with perfectly smooth grooves and cyanide hardened. The outer ball cage was made of bronze and pened to retain the balls.

The shaft *S* is drilled throughout its length to take the actuating-rod *X*. Drilling was carried out from both ends, the holes meeting perfectly in the centre, ends countersunk at 60 deg. and used as centres for final turning, thus ensuring concentricity of the bore.

A transverse slot $\frac{7}{16}$ in. long by $\frac{3}{16}$ in. wide was cut in the shaft, as shown, to take a hardened pad-piece *P* $\frac{5}{16}$ in. wide by $\frac{3}{16}$ in. thick fitted diametrically in the bore of *B*, and which presses on the end of sleeve *D*. The actuating-rod *X* has an adjustable end *Q*, hardened, and which presses against the pad-piece *P*. The movement



SECTION & PLAN OF CONTROL

of the cone member is only $\frac{1}{16}$ in., and ample room to accommodate this is allowed in the shaft slot.

The cone *B* is held in engagement by means of the spring *F*, a motor-cycle o.h. valve spring. The spring is located truly by the loose stepped ring *E* and the screwed adjustment ring *G*, the latter locked by nut *H* on the $\frac{5}{8}$-in. × 26 t.p.i. thread on the end of the shaft.

To exclude dirt and swarf from the pulley thrust-bearing *J*, a ring guard *I* is mounted on a spigot on the back of *A* and revolves with it.

A feather key *O* is fitted, on which slides the internal gear pinions, and which replaces the original one.

Lubrication

The clutch is self-lubricating from oil within the machine-head. A small longitudinal oil hole is drilled down the bearing housing, meeting a radial one from a $\frac{3}{16}$ in. wide space between the two units of the shaft bush; a corresponding radial hole is drilled at the bottom, but is not shown. The longitudinal hole is supplied from an angular hole drilled at 45 deg., and which opens to the shaft at the bottom, and to one of the two slots cut at 45 deg. at the top. The slots are for the easy removal of the stationary member of the thrust-race which is sunk into the end of the bearing housing. The oil holes are filled with worsted wick which controls the supply and acts as a filter.

The Control Unit

Control of the clutch is carried out by a rotating cam *V* which incorporates limit stops. The cam is rotated by the vertical shaft *U* on the top of which is an arm or lever terminating in a "Ford" gear lever knob. The arm can be placed in any convenient position. In my case, it faces the front when the clutch is disengaged, movement to the left (i.e. the same direction as the lathe saddle usually moves) engaging the clutch.

Working against the cam *V*, and interposed between it and the end of the actuating-rod *X*, is the hinged tappet *W*, located by, and hinging on, a pin *T* secured at the ends with ordinary $\frac{1}{16}$-in. split cotter-pins. Both cam and tappet are hardened.

Both shaft *U* and pin *T* are housed in a bracket fabricated from steel. The bracket is made in a form that fits over the outer rim of the existing lathe-bearing housing, and is held to it by five 2-B.A. C.H. screws, (not shown).

The respective bosses were made each in one piece, fitted in the webs, and the whole brazed to the recessed back-piece at one heat, the spaces for the cam and tappet being machined away afterwards.

It will be seen that the cam *V* has two flats at 45 deg., this being the travel of the operating arm. The radial difference in the depths of the two flats is $\frac{1}{16}$ in., and the flat surfaces give a definite locking effect to the cam. The cam is located on the vertical shaft *U* by means of a 2-B.A. grub-screw, the desired position of the handle being obtained first before "dimpling" the spindle for the grub-screw.

The only alteration necessary on the bearing housing itself was the drilling of the domed steel end cap fitted in its outer end, and the drilling and tapping of the five retaining screws in such a position as to clear the three C/S screws which retain the housing in place in the headstock casting *M*.

Operation

The clutch is extremely "sweet" and quiet in operation, and the lathe mandrel can be "inched" or made to rotate very slowly, irrespective of the gear ratio engaged. No slip occurs on the heaviest loads, and no sign of wear is evident on the leather; in fact, the presence of oil on it seems to improve its action.

With only minor modifications, the clutch could be adapted for ordinary "open" drive, substituting a stepped pulley for the internal sliding gears as in a machine such as mine, and supporting the shaft in an outside independent frame on which could be mounted the motor.

For the Bookshelf

Modern Locomotives, by Brian Reed. (London: Temple Press Ltd.) 87 pages, size $7\frac{1}{4}$ in. by $9\frac{3}{4}$ in. Illustrated. Frontispiece in colour. Price 9s. 6d. net.

This is the second edition of an excellent book, one of its publishers "Boys' Power and Speed Library," and should be in the possession, not only of a railway-minded boy, but of any uninitiated reader who may have a liking for, but little knowledge of modern railway locomotives. Steam, electric, diesel, gas-turbine and certain special types are all dealt with, briefly but lucidly, in a style that is easy to read and to understand.

The illustrations consist mostly of photographic reproductions on art-paper inserts, though a number of drawings and diagrams are interspersed in the text.

It is a book that provides a firm basis on which to build up a more detailed knowledge of an important and interesting subject.

A TWIST DRILL POINT GRINDING JIG

by W. D. ARNOT

JIGS are not in very common use for drill point grinding. That is partly the fault of the jigs, which are not simply and speedily set up and used, and partly the result of general experience that nine holes out of ten need not be precision drilled; drilling is a roughing operation in most cases.

When precision drilling has arisen, some of us have wished there were some certain way of grinding the drills precisely, at no great cost in tackle. The ability of individuals to grind free-hand successfully varies immensely and the most

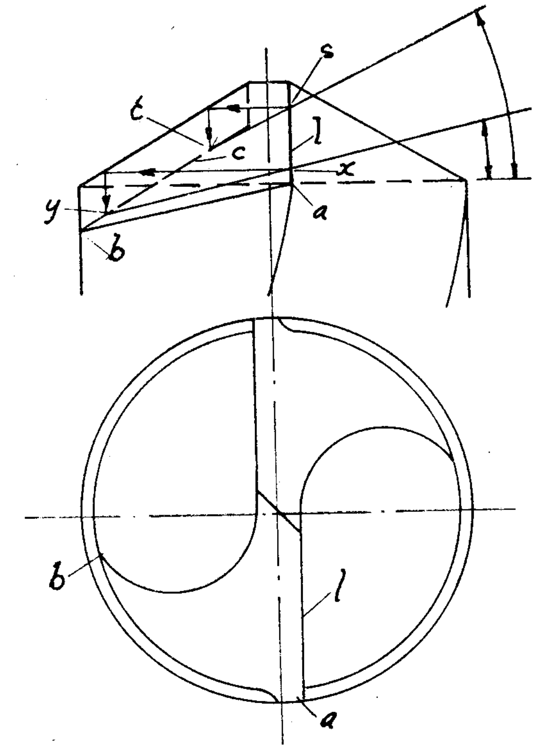


Fig. 1. How relief angle should increase

skillful will disparage jigs. I wonder sometimes if they also disparage dies for cutting threads.

Most model engineers have limited time, limited equipment and limited opportunity to receive skilled instruction, but they have unlimited resource. Many have a job in view that is not the skilled grinding of drills, but demands accurate use of them. Such people would like a handy jig.

The smaller the drill the more difficult it becomes to grind whether free-hand or by jig, and those who have thought about making a jig will appreciate how slight a variation can destroy its utility. It is really a very difficult thing to make to be effective. An attempt has been made to simplify as far as possible the difficulties of construction in the jig to be described.

The drill manufacturer uses a machine of some kind to point grind the drills, and users tend to accept them as correct off the shelf. I have first tried to find out how correct they are as manufactured, as a gauge to the accuracy likely to be achieved with a jig. I conclude that the jig will have to do better.

Here are some interesting observations which appear in the publication *Practical Drilling Tests*, by Dr. D. F. Galloway, Director of Research,

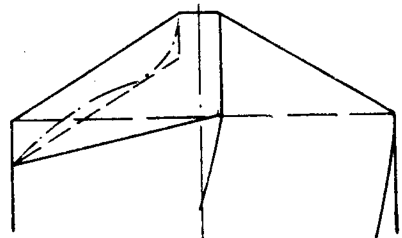


Fig. 2. The actual profile seen

Production Engineering Research Association, and I. S. Morton, Senior Investigator, a book that is a fund of measured information about commercially-produced drills. I have Dr Galloway's kind permission to quote.

The authors conclude, from measurements, that some makers and users of drills are not aware of the extent of error in commercially-produced drills and accept a low standard of drill performance in consequence.

Of particular interest to us here are the observations: Page 181, "Apart from the general consideration of symmetrical point angle, the three most common and most important sources of error in drill grinding are: Relative lip height; Relief; Point thinning. Of the three, relative lip height has undoubtedly received least consideration by drill users and makers and is today (1946) a major cause of imperfection in drill performance." In confirmation, page 14: "Errors in lip height are common even in machine-ground drills. In a long series of tests on new $\frac{3}{8}$ in. diameter drills it was found that relative lip height generally varied from 0.003 in. to 0.005 in. but values over 0.010 in. were sometimes present."

A table, page 15, shows that if 0.010 in. were indeed the difference in lip height, a $\frac{3}{8}$ in. drill, fed at 0.018 in. per revolution, would still only cut with one lip. (Handbooks advise a feed between 0.010 in. and 0.015 in. per revolution for this size, high speed drills in mild-steel.) On

page 108 a table shows that drills with relative lip height 0.002 in. to 0.003 in. would drill 0.010 in. to 0.020 in. oversize—new drills these, from the makers, all $\frac{5}{8}$ in diameter. A table, page 79, shows how relief angle varied from lip to lip by varying amounts at differing radius and was generally of the order 2 or 3 deg. difference, but much more on occasions.

An accurate jig then is something rather difficult to make even for drills of $\frac{5}{8}$ in size. I can only claim that the jig to be described grinds well as measured by the fit of hole attained when the drill ground on it is used I have not precision equipment to check relative lip height (and few factories have)—that may be a future venture.

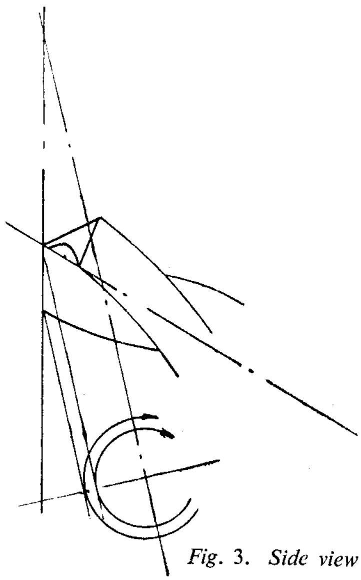


Fig. 3. Side view

The great puzzle that first harassed me in setting out to make a jig was : " What exactly is a drill point grinding jig required to do ? " I studied a variety, and became more confused by their differences in construction. But something comes to light in such a study, and I hope the following way of looking at the requirements may be clear to others.

Consider Fig. 1, the unground true cone on a drill point. A line shows where peripheral clearance of 12 deg. would lead from the outer tip of the cutting edge ; starting at *a* it finishes at *b*. If all the rest of the length of the cutting edge *l* is to conform to that amount of drop, then the relief line must end up parallel with the original cone line, as shown by broken line *c*. If it does so, a point *x* on the cutting lip instead of remaining on cone level square to the axis, drops to *y* on line *c* and a point *s* nearer the web, bridge or chisel point, drops from cone level to *t* on line *c*. Join *x*-*y* and *s*-*t*, extending these lines. It is seen clearly that the clearance angle has increased a lot towards the chisel edge.

You will say, but if I look at a drill in that direction, what I see is the chain-dotted shape Fig. 2. That is so, and because we do not look across solid metal in one plane ; the flute milling has cut towards the cutting edge so that intermediate regions are at a higher level, and as the flute meets the web the curve sweeps up to meet it.

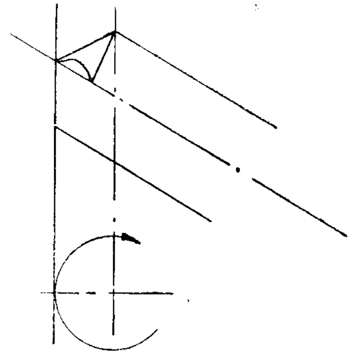


Fig. 4. Side view

I have searched in many places to find how much the relief angle must increase towards the point and no authority gives a figure. But I have had my own calculations confirmed and they are these : If you take a 1 in. diameter drill and feed it at the advised rate of 0.015 in. per revolution, to clear that rate of feed you require at the periphery an angle of 0 deg. 17 min. At the same rate of feed, at $\frac{1}{8}$ in. diameter which is about the web thickness, you require a clearance angle of 2 deg. 11 min. That is, to clear feed rate the angle has to increase less than 2 deg. from periphery to web. Note also that more than $11\frac{1}{2}$ deg. of the peripheral relief angle of 12 deg. are not essential for feed clearance. What then is the purpose of it ?

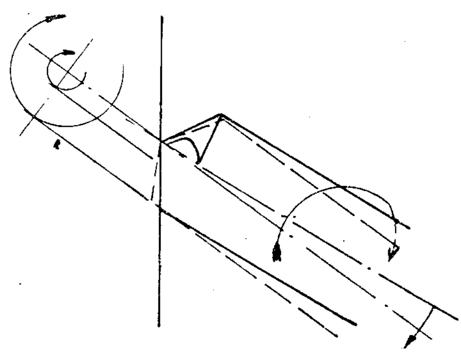


Fig. 5. Plan view

The explanation given is that a drill ground with those small angles would cut freely. But once slight wear took place, the flat at the cutting edge would set up such a heavy feed resistance that the drill would split. With a keener angle it can wear some way before the flat becomes anything like as wide.

We have an idea now what shape and to what angles we must grind. Let us see how the usual jigs do it in principle. There appear to be two general principles. One rests the drill in a

Steady Rests for the Lathe

by "Base Circle"

IT is surprising how many lathe workers carry on year after year without proper steadies. Probably this is partly because of the cost and partly because they don't fully appreciate the great utility of such appliances. Well there is no doubt that lots of good work can be done without the use of steadies, but at the same time if they are available many jobs become much easier, and it will be found that they are used more often than one would expect. In the writer's case it must be admitted that the lathe was without a fixed steady for many years—all sorts of makeshifts being used instead. It was only when a job cropped up (actually it was the repair of a lorry half-shaft) which was so long that it overhung the bed of the lathe by about 6 in., that the steady shown in Fig. 1 was made. I may add that with the help of the steady, that job was successfully completed. One end of the shaft was held in a chuck—the other ran in the steady placed at the extreme end of the bed—and the tool was carried in a bar bolted to the top-slide and projecting beyond the steady to operate on the end of the shaft. No doubt a very "Heath Robinson" set-up, but the job was done, and that was all that mattered.

A steady of the usual design is, of course, quite an expensive luxury, at least to the normal impecunious amateur, but the design shown will be found to result in quite an efficient article, and the cost need not be very high, provided

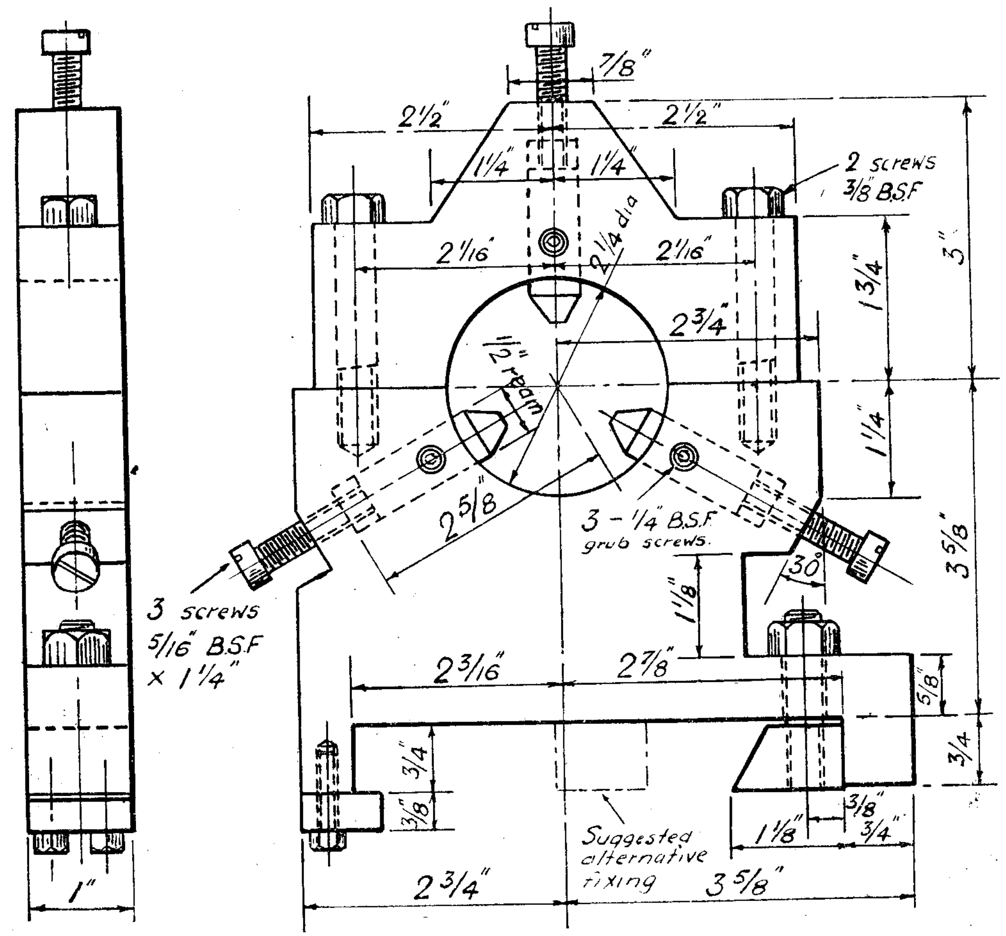


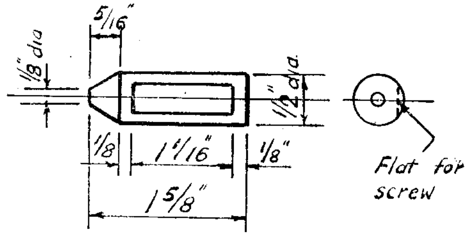
Fig. 1. A fixed steady for the $3\frac{1}{2}$-in. Drummond lathe

one is prepared for a lot of hard hand work. The steady is certainly not so quick in action as the usual hinged type, which we admire in the catalogues ; but, after all, we are not on production and a few seconds should not matter so very much. It will be seen that the upper part is held on by two screws which have to be completely withdrawn to allow the work to be put in position —though sometimes it will be found possible to thread the work through by merely slackening off the top steady pad.

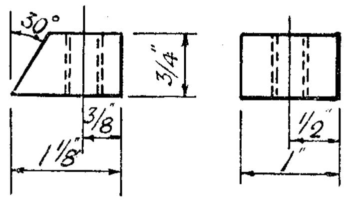
Constructing the Body

The body is made from steel plate 1 in. thick —rather a hefty job to tackle with hack-saw and file, but if the help of somebody with an oxy-acetylene burner can be enlisted there will be no great difficulty. The writer's steady was burned out with the cap integral with the bottom part, but I don't know that that was such a very good idea after all. The sawing apart of the two was quite a job. The joint faces were milled by bolting each part in turn to the lathe saddle at a convenient height and using a fly-cutter held in the four-jaw chuck. The same method was adopted to machine the base to fit the lathe bed. As shown, it is arranged to suit the old Drummond $3\frac{1}{2}$ in., but it could readily be modified to suit any other make of machine. In the case of the Drummond it would have been better to leave a lug as shown in chain-dotted lines so that the clamping stress would come entirely on the front shear. As made, there must be a tendency to pull the two shears together, but all I can say is that during about fifteen years' use no trouble has arisen. The making and fitting of the vee-locking pad is a simple matter. The pad which fits under the rear way was merely made a very good fit over the thickness of the way, but some workers may prefer to use it as a clamp. If so, one screw could be used with two dowels to locate it.

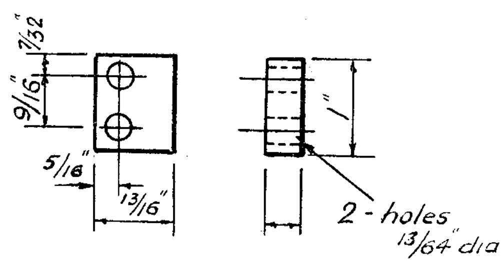
(*Continued on page* 361)



Steady pads. (3 *off, brass or bronze*)



Clamping block. (1 *off, M.S.*)



Clamping plate. (1 *off, M.S.*)

Fig. 2

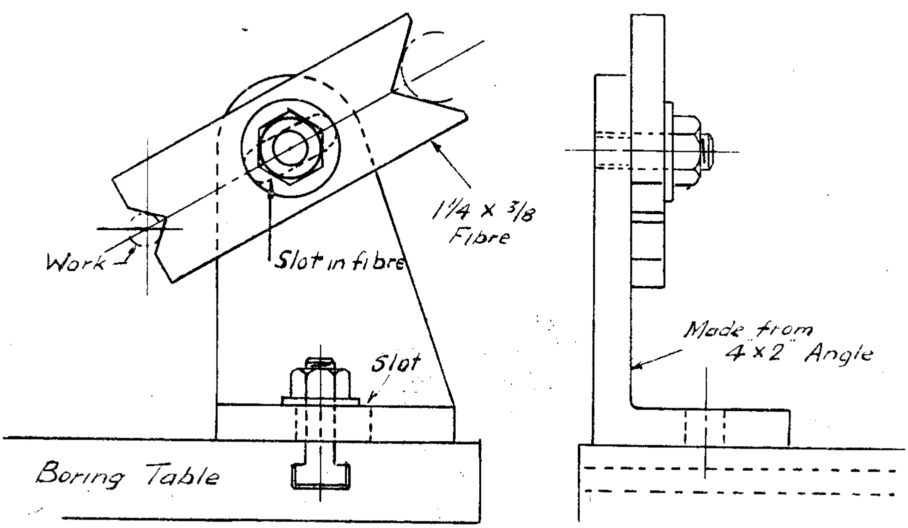


Fig. 3. *Travelling steady*

FITTING RODS WITH FORKED ENDS

THE forked ends fitted to link levers and control-rods of round section are usually best made from a solid piece of material, but a flat rod is more easily fitted with a connecting fork built up from additional pieces of strip material, riveted or hard-soldered in place, or secured with screws.

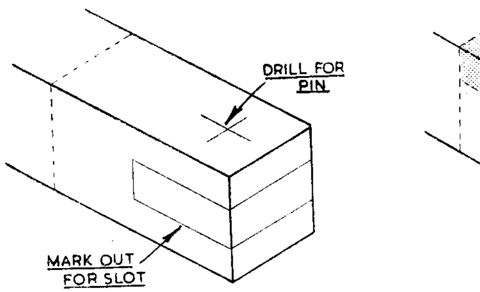


Fig. 1. Marking-out the fork slot and joint pin hole

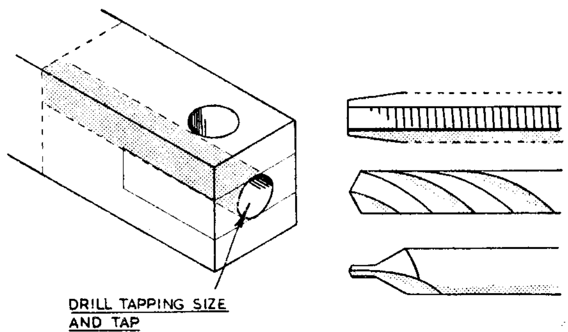


Fig. 2. Threading the work axially in the lathe

Machining Forked Fittings

When making a forked member to screw on to the end of a round rod, a drawing or dimensioned sketch should first be made. A length of bright, square mild-steel, some three or more inches in length, is next filed flat and square on its sides and at one end. The position of the cross-pin is then marked out and the bearing hole is drilled truly square right through the material. The work is next mounted in the four-jaw chuck and is centred by applying the test indicator, in turn, either to the four corners, or to the flat faces when aligned vertically by means of a square resting on the lathe bed.

Take a light facing cut across the end of the work to provide a datum face for future use. Next, form a centre with a centre drill held in the tailstock drill chuck, nd feed in a drill of the tapping size for rather more than the full length of the finished part. This hole is now tapped from the tailstock to the full depth ; but if the tap is not long enough to do this, the hole is drilled out for some distance to the clearing size.

The work is then removed from the chuck for marking-out the slot in the end of the fork. For this purpose, the bar is laid on the surface plate, and the surface gauge is used to scribe a line, indicating one side of the slot, right round the end of the work. Then turn the work over and repeat the scribed line ; this will ensure that the slot is marked out centrally.

If the rigidity of the lathe for milling is in doubt, put through a drill hole at the bottom of the marked-out slot and remove the surplus metal with a hacksaw. To mill the slot to shape, the work is clamped in the lathe toolpost and set parallel with the chuck face ; at the same time, the centre-line of the bar is set at lathe centre height. A circular cutter, mounted on an arbor supported by the tailstock centre, will give a good finish to the work, and by taking a series of cuts, with the saddle locked, the slot is

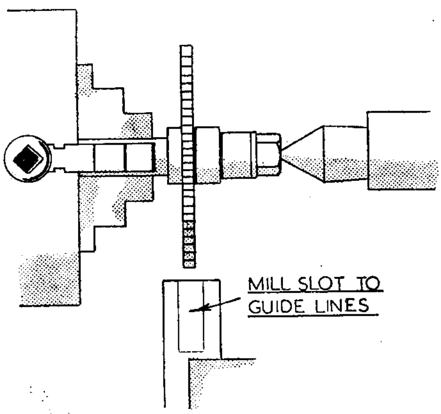


Fig. 3. Milling the fork slot

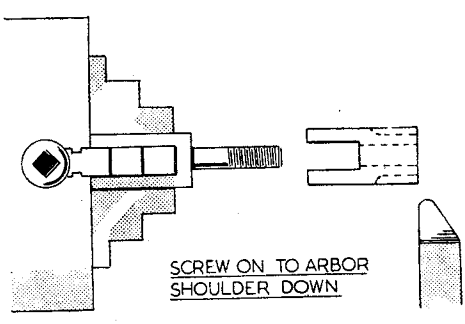


Fig. 4. Facing and shouldering the fork

machined to the width indicated by the scribed guide-lines. Where a hole has been drilled at the bottom of the slot, the surplus metal can be removed and the slot cut to width by doing the machining with a circular metal saw. A fly-cutter will also serve for shaping and sizing the slot once it has been roughed out. However, if an end-mill is employed for the machining, the work may have to be gripped in a machine vice secured to the vertical-slide in order to obtain the necessary feed movements; this will save having to adjust the height of the work with packings when, instead, the bar is held in the toolpost. After the slot has been finished to size, the fork is cut off to length.

To machine the other end of the fork, the work is screwed on to a length of threaded rod gripped in the chuck, and the faced ends of the fork then abut against the chuck jaws and help to maintain the work in alignment. With the part so held, its end is faced and then shouldered down to give a finished appearance.

When fitting the finished fork to its rod, the rod can be shouldered and then threaded or, if a range of adjustment is required, a lock-nut is fitted to the threaded end of the rod.

A neater job will be made if the nut is drilled out for a short distance to the clearing size so as to shroud the exposed threads.

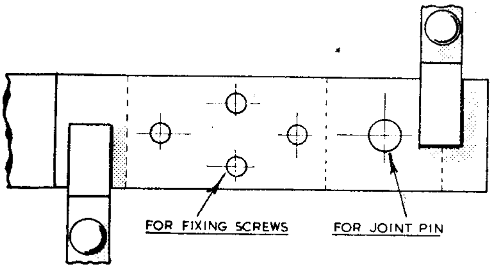


Fig. 5. Marking-out the fork member

Built-up Fork Ends

Link-rods and control levers made of flat stock can readily be fitted with forked ends by securing two short lengths of flat material to the central bar. Some forked rods should, of course, be machined from the solid, but for some purposes the built-up kind will serve equally well, and both time and material may be saved. There are several ways of carrying out this work, some haphazard, but the following method should ensure that the joint pin stands square and that the parts, when made detachable, will always fit together correctly.

After the material has been filed or machined flat and square, one of the side members is marked out to locate the joint pin and the fixing screws or rivets. Both the central bar and the two side members will have to be made rather longer than the finished length, in order to allow room for the clamps and for the blocks used to support the work on the drilling table. When the two limbs have been clamped in place on the bar with a pair of toolmakers clamps, the assembled work is transferred to the drilling machine and rests on parallel packing blocks to keep the clamps clear of the table surface. A centre drill is first fed in, and the hole to receive a parallel joint pin is drilled to reaming size and then finish reamed; if the reamer is not put right through the work, the slight taper remaining will provide a secure fixing for the joint pin when pressed into place.

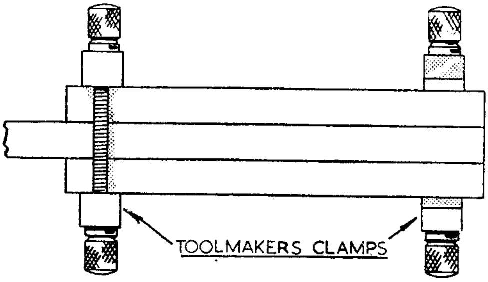


Fig. 6. Clamping the parts for drilling

Where the parts are secured with rivets, the holes should be drilled an easy press-fit and then lightly countersunk, so that the rivets, after being closed, can be filed flush.

If cheese-headed screws are fitted, the holes are first drilled right through to the tapping size, and are afterwards opened out to the clearing size only as far as the upper surface of the lower fork member. By so doing, the tap will be well-guided when threading the holes for the fixing-screws. Before the clamps are removed and the work taken apart, the parts should be clearly marked to ensure that they are reassembled in the original positions. The holes in the upper side-member are now drilled to take the screw heads, and a uniform depth is maintained by setting the drilling stop.

Where work of this kind has to be taken apart, perhaps several times, during the course of construction, it is a good plan to use temporary screws, preferably of brass so as not to disfigure the finished work. On reassembling the work, after all burrs have been removed, the central bar and the two side members are marked out and then cut off to the finished length.

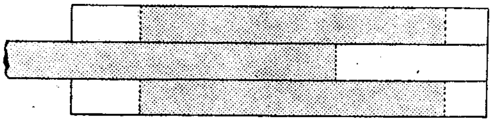


Fig. 7. The surplus metal is cut off

To ensure that, on assembly, the side members are correctly and positively located, the fixing-screws may have to be specially made, for only their ends should be threaded and the plain shanks are made an accurate fit in their holes.

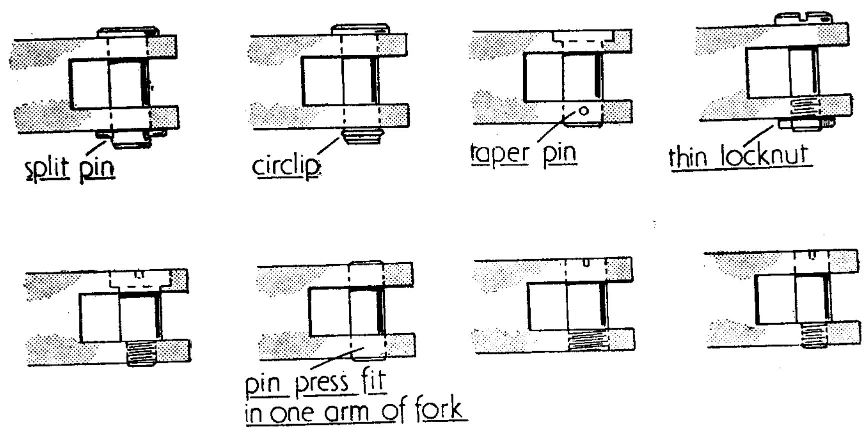


Fig. 8. Some joint pin fixings

The Joint Pin

The joint pin should be hardened or case-hardened if subjected to wear.

Various ways of fitting the joint pin are illustrated, and it will be seen that in some the pin is restrained from turning in order to save wear in the fork ends, and in others the pin is only located endways, but is free to turn.

However, the type of fixing adopted must depend on the duty required of the joint. Where a threaded pin is fitted, it should be put in from the proper side, so that any movement in the forked joint will tend to tighten and not to unscrew the joint pin.

Steady Rests for the Lathe

(*Continued from page* 358)

When the fitting to the bed had been completed, the holes for the cap-studs were drilled and tapped, and clearing holes were drilled in the cap itself. With the cap bolted in place the whole contraption was mounted on an angle plate bolted to the lathe saddle and the central bore was cleaned up. It should be noted that apart from the fitting to the bed and the fit of the steady pads, no great accuracy is called for. The steady, as shown, allows for work up to about 2 in. diameter. This is a bit less than the commercial type of steady takes, but it was felt that bars bigger than 2 in. diameter were out of place on a 3½ in. lathe. Nevertheless, I have no doubt that sooner or later the steady will be bored out to accommodate something just a little bit bigger.

The holes for the steady pads were next tackled. They were marked off while the two parts were bolted together. Next, the cap was taken off and the holes were carefully bored and reamed.

The rest of the work is all plain sailing and with a little care quite a creditable and workmanlike job will result.

Probably a lot of hard work could be avoided if an aluminium casting were used instead of the steel plate. I have no doubt it would do quite well, though it would not be so durable. It would certainly be necessary to allow more depth of metal for the screws.

The travelling steady shown in Fig. 3 is a very simple device. So simple that it is not necessary to give any details. It consists of a suitable angle plate to which is bolted a steady plate of fibre. The plate is double ended, the small vee at one end accommodating small work while the larger vee at the other end suits the larger jobs. Crude though it may be, this simple gadget will be found to be perfectly effective. It will do all that the usual type with adjusting screws will do, and it will cost next to nothing. Extra steady pads to suit special jobs can be provided when required.

With a steady of this kind mounted on the boring table, it is necessary to use the top-slide to put on the feed, keeping the boring table locked. On a lathe of the usual production type the steady is, of course, carried on the fixed part of the saddle so that its position relative to the centre-line of the lathe remains constant, but this is rather difficult to arrange on the type of lathe owned by most model engineers.

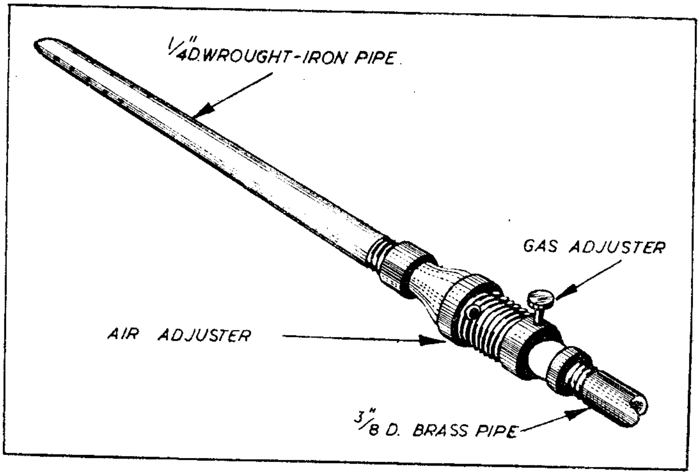
PRACTICAL LETTERS

Making a Gas Poker

DEAR SIR,—An easy way to make this if one has a good second-hand inverted gas burner, universal size, is to take the globe-ring off, get a piece of ¼-in. iron pipe, screwed at one end, and welded at the other approximately 18 in. long with two rows of five small holes. A short piece of ⅜-in. brass or copper tube at the burner end for the flex, and the poker is complete. I have one that I made and is satisfactory, and the gas and air can be regulated.

Yours faithfully,

Kenilworth. T. JONES.



The Lost Wax Process

DEAR SIR,—At the risk of appearing rather pedantic, may I ask if "Foundryman" is quite correct in writing "Ciri-Perdu" (page 188, August 7th)? Wax is cire, and it is feminine, so surely it should be "Cire-Perdue," with or without hyphen as you prefer. But what really intrigues me is how the "i" got into it.

Yours faithfully,

London, W.1. JOHN H. AHERN.

Curved Spokes

DEAR SIR,—I do not profess to be really interested in the subject of flywheels with curved spokes; if, in fact, I make a flywheel, it has straight spokes because I think they look better. But, as a regular reader of THE MODEL ENGINEER, I cannot fail to have had my attention drawn to the subject by the many letters thereon.

It does surprise me, however, that the rather obvious reason for the curved spokes would seem to have been ignored by the majority of your correspondents. I refer to the fact that they were the result rather of the artistic inclination of their designer than of his scientific calculations. I believe that their origin has a common parent with the gryphon's feet on my bath at home. At one time in the not too distant past it would appear that no one ever made use of a straight line where a bunch of grapes would do!

Mangle wheels were cast with curved spokes, and I would like to see even the proverbial Mrs. Jones turn with such a power as to burst one!

Yours faithfully,

Gresford. B. TERRY ASPIN.

[*And there, we think, we will leave it.*—ED.]

The Contractor's Locomotive "Teacup"

DEAR SIR,—I was so interested to see a picture of my engine in your issue of May 29th that I did not bother further about the fact that it had been attributed to someone else.

May I thank Mr. J. W. Mercer, of Newton le Willows and also "Northerner" for the trouble they have taken over this matter, and also you sir, for allotting valuable space to this correspondence.

Yours faithfully,

Chester. R. FARRER JAMES.

Balancing of Engines

DEAR SIR,—Thank you very much for publishing, and Mr. D. H. Chaddock for writing the article "Locomotive Balancing" in THE MODEL ENGINEER, August 7th issue. The balancing of my split-single puzzled me at the time, and I decided to treat it as two single-cylinder engines. I now realise how wrong I was.

Yours faithfully,

Runcorn. R. E. MITCHELL.

Camera Design

DEAR SIR,—Mr. S. Widdas recently passed some comments on the article "Camera Design" by Raymond F. Stock and I would like to point out two other errors for the benefit of would-be camera constructors.

In Fig. 32 on page 235 of the issue for February 21st, 1952, is shown the basis of a twin reflex camera. Should anyone intend building a camera of this type they would be well advised to position the tap spool behind the mirror towards the top left-hand corner. This allows the mirror to be lowered by some considerable distance bringing the two lenses closer together and thereby reducing the parallax effect.

The other point, but a small one, is that in the same Fig. the emulsion seems to be on the outside of the film. Other than these small points, I would join Mr. Widdas and congratulate Mr. Stock on his article.

Yours faithfully,

Cheltenham. D. W. SMITH.